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OFFICE OF CHEMICAL SAFETY AND POLLUTION PREVENTION

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MEMORANDUM

Subject: Addendum to 2,4-D Choline Salt Section 3 Risk assessment: Refined Endangered Species Assessment for Proposed New Uses on Herbicide-Tolerant Corn and Soybean for AR, KS, LA, MN, MS, MO, NE, ND, OK, TN

To: Emily Schmid, Risk Manager Reviewer
Kathryn Montague, Product Manager Team 23
Dan Kenny, Branch Chief
Herbicide Branch
Pesticide Registration Division (7505P)
Office of Pesticide Programs

From: Edward Odenkirchen, Ph.D., Senior Science Advisor
Meghan Radtke, Ph.D., Biologist (Acting Risk Assessment Process Leader) 9/26/14
Sujatha Sankula, Ph.D., Branch Chief 9/26/14
Environmental Risk Branch 1
Environmental Fate and Effects Division (7507P)
Office of Pesticide Programs

The Environmental Fate and Effects Division (EFED) issued a screening level risk assessment for a Federal action involving proposed new uses of the 2,4-D choline salt on herbicide-tolerant corn and soybean in January, 2013 (DP 400223, 400230, 400234, 400237, 405028, 405812); an amendment to the assessment was issued on June, 2013 (DP 411614). This document considers the screening risk assessment, mammalian effects endpoint characterization in DP 418022 and additional information supplied by the registrant (principally species habitat information assembled as part of a listed species effects assessment document summarized in DP 421678) and addresses the listed species found in 10 states: Arkansas, Kansas, Louisiana, Minnesota, Mississippi, Missouri, Nebraska, North Dakota, Oklahoma, and Tennessee (AR, KS, LA, MN,

MS, MO, NE, ND, OK, TN) following the same general approach as the previous 6-state assessment (DP 411614).

Overall, the screening level risk assessment determined that direct risk concerns were unlikely for birds (chronic), aquatic plants (vascular and non-vascular), freshwater fish (acute and chronic), estuarine/marine fish (acute and chronic), freshwater invertebrates (acute and chronic), estuarine/marine invertebrates (acute and chronic), and terrestrial insects. Potential direct risk concerns could not be excluded for mammals (acute and chronic); birds, reptiles, and terrestrial-phase amphibians (acute); and terrestrial plants. Indirect effect risk concerns for all taxa were possible for any species that have dependencies (e.g., food, shelter, and habitat) on mammals, birds, reptiles, terrestrial-phase amphibians, or terrestrial plants.

The purpose of this addendum is to conduct an effects determination for all federally listed species expected to exist within the action area proposed for this registration of 2,4-D choline salt for use on corn or soy in AR, KS, LA, MN, MS, MO, NE, ND, OK, and TN. Based on EFED's LOCATES database and information from the US Fish and Wildlife Service, 168 species in the 10 states proposed for registration were identified as within the action area (at a preliminary county-wide level of resolution) associated with the 2,4-D-tolerant corn and soybean uses.

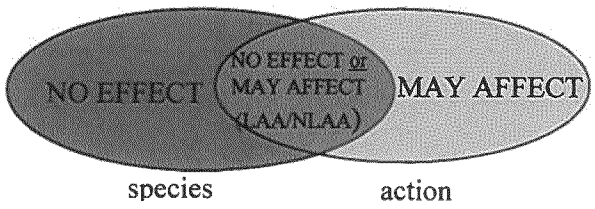
EFED has refined the endangered species risk assessment on the basis of spray drift mitigation language that has been added to the label. Specifically, the spray drift language limits applications to specific product nozzles and a specific formulation of the 2,4-D choline product It requires the use of a 30 ft on-field buffer when the wind is blowing towards all areas that are not fields in crop cultivation, paved areas, or areas covered by buildings and other structures. Species-specific biology, and 2,4-D application timing information are also incorporated into this refined endangered species assessment. The following text discusses the lines of evidence and processes that were used to make effects determinations for listed species identified as potentially at-risk in the screening level assessment.

Making an Effects Determination

The bullets below outline EFED's process for making an effects determination for the Federal action:

- For listed individuals inside the action area but **NOT** part of an affected taxa **NOR** relying on the affected taxa for services (involving food, shelter, biological mediated resources necessary for survival/reproduction), use of a pesticide would be determined to have NO EFFECT.
- For listed individuals outside the action area, use of a pesticide would be determined to have NO EFFECT.

- Listed individuals inside the action area may either fall into the NO EFFECT or MAY AFFECT (LIKELY or NOT LIKELY TO ADVERSELY AFFECT) categories depending upon their specific biological needs, circumstances of exposure, etc.



  - LIKELY or NOT LIKELY TO ADVERSELY AFFECT determinations are made using the following criteria:
    - Insignificant - The level of the effect cannot be meaningfully related to a "take."
    - Highly Uncertain - The effect is highly unlikely to occur.
    - Wholly beneficial - The effects are only good things.

Spray Drift Mitigation

There are 168 species of potential concern in the 10 proposed 2,4-D choline corn and soy states as a result of the screening-level assessment (Appendix 1). The spray drift mitigation language of the product is intended to limit off site transport of 2,4-D choline drift to the extent that no off site area that could potentially provide non-target organism habitat will receive loadings that will trigger concerns for **any** terrestrial receptor class assessed in the risk assessment (terrestrial vertebrate, invertebrate, or plants). The assessment assumes that spray drift will remain confined to the field and that the action area is limited to the 2,4-choline treated field when applied according to the label. Terrestrial species that are not expected to occur on treated fields under the provisions of the proposed label are not expected to be directly exposed to 2,4-D choline, nor are their critical biologically mediated resources expected to be exposed to levels of the herbicide above any effects thresholds of concern. [Note: the screening level risk assessment has concluded no aquatic receptor taxa to be of concern.] Consequently, 157 of the 168 species originally identified as potentially at-risk can be given a "no effect" determination based on the premise that they are not expected to occur on an action area encompassing the treated soybean and corn fields (Appendix 2).

The spray drift mitigation label language cannot preclude listed species exposure on treated fields, should a listed species utilize such areas as part of its range. Of the listed species within the 10 states (AR, KS, LA, MN, MS, MO, NE, ND, OK, TN) considered part of the proposed Federal decision, the Canada lynx (*Lynx canadensis*), gray wolf (*Canis lupis*), Indiana bat (*Myotis sodalis*), Ozark bat (*Corynorhinus townsendii ingens*), Louisiana black bear (*Ursus americanus luteolus*), whooping crane (*Grus americana*), Mississippi sandhill crane (*Grus canadensis pulla*), lesser prairie-chicken (*Tympanuchus pallidicinctus*), gopher tortoise

(*Gopherus polyphemus*), American burying beetle (*Nicrophorus americanus*), and the Spring Creek bladderpod (*Lesquerella perforata*) are reasonably expected to occur on treated soybean and corn fields. Therefore, species specific biological information and 2,4-D choline use patterns were considered in more depth to further refine the assessment and effects determinations.

Mammals

The screening-level assessment suggests that mammals could be at reproductive risk from chronic exposures to 2,4-D choline on treated fields. Of the mammal species identified as potentially at risk in the screening-level assessment, five are reasonably expected to occur on treated soybean and corn fields. Therefore, species specific biological information and 2,4-D choline use patterns were considered in more depth to further refine the assessment and effects determinations for those species.

Canada Lynx

In light of the expected reliance on boreal habitat for foraging and the absence of this habitat on 2,4-D choline treated soybean and corn fields as discussed in the previous 6-state assessment (DP 411614), it is not reasonable to expect that the Canada lynx will be exposed to 2,4-D choline residues in small mammals (prey) from treated soybean and corn fields. **Therefore the Agency believes it is reasonable to conclude a "no effect" determination for the Canada lynx under prescribed conditions of the use of 2,4-D choline under this Federal action.**

Gray Wolf

Gray wolves are habitat generalists that live throughout the northern hemisphere. They are a carnivorous species that typically feeds on ungulate species, such as deer. While not likely to feed on agricultural fields themselves, the primary prey species of the gray wolf may be expected to feed on plant material within the field during the period of applications. Based on this information, it is reasonable to conclude that the gray wolf may be exposed to 2,4-D choline residues in prey. A biologically representative modification to the screening assessment follows:

The first step in the refinement process is to calculate 2,4-D residues in the prey species. Using the conservative assumptions that the prey species is represented by a 1000 g mammal that feeds exclusively on short grass, EFED calculated the residues based on the following allometric equations:

1000 g mammal prey ingestion rate (dry) = $0.621(1000)^{0.564}$ = 30.56 g /day
1000 g mammal prey ingestion rate (wet) = 30.56/0.2 = 152.8 g/day
2,4-D residue in prey eating short grass from T-REX = 578.44 mg 2,4-D/kg-food X 0.1528 kg food/kg-bw = 88.40 mg/kg-bw/day

The next step is to calculate the expected daily dose for a typical 17.7 kg (17700g) gray wolf, the adjusted NOAEL value, and the chronic dose-based RQ for the gray wolf based on the following allometric equations:

Food intake (wet) = $((0.235(17700\ g)^{0.822})/(1-0.69))/1000$ = 2.35 kg wet/day
Dose-based EEC in wolf eating small mammal = 88.40 mg 2,4-D/kg wet X 2.35/(17700/1000) = 11.74 mg/kg-bw/day
Adjusted Acute LD50 = 441 mg/kg/day X $(350/17700)^{(0.25)}$ = 165.37
Adjusted NOAEL = 55 mg/kg-bw X $(350/17700)^{(0.25)}$ = 20.62 mg/kw-bw
RQ for acute effects = 11.74/165.37 = 0.07
RQ for chronic effects = 11.74/20.62 = 0.57

An acute RQ of 0.07 does not exceed the level of concern (LOC) of 0.1 for acute effects to listed species. A chronic RQ of 0.57 does not exceed the LOC of 1.0. **Consequently, it is reasonable to make a "no effect" determination for the gray wolf.**

Indiana Bat

A past assessment for corn and soy uses of 2,4-D choline for other states (DP 418022) concluded that Indiana bats make use of agricultural land as a source of prey and can reasonably be expected to roost in patches of fragmented forest that are adjacent to corn and soybean fields. They are opportunistic foragers and are expected to forage over many different land covers, including agricultural land, on a broad range of insects/arthropods. A survey of corn insect populations reveals a variety of flying, foliage and ground-dwelling invertebrates comprising a large number of taxonomic groups that could provide on-field prey sources for bats foraging over these areas. However, the extent of foraging over agricultural land is expected to be less than the degree of foraging around the canopies of forested areas.

Initial screening level risk assessment results for mammals were adjusted to account for the bat's biology:

Field metabolic rate kcal/day = $0.6167(5.4)^{0.862}$ = 2.64 kcal/day
(USEPA 1993, body weight 5.4 g reflects screening assumption for the Indiana bat)
Mass of prey consumed per day = (2.64 kcal/day)/(1.7 kcal/g ww X 0.87) = 1.78 g/day
(1.7 is energy content of prey item from USEPA (1993); 0.87 is assimilation efficiency from USEPA 1993)
Mass of 2,4-D choline in insect diet = 226.56 mg/kg-ww from T-REX run
Mass of 2,4-D in daily diet = 1.78 g/day X 226.56 mg 2,4-D/kg-ww mammal prey X 0.001 = 0.40 mg/day
Daily dose in bat = 0.40 mg 2,4-D/day/0.0054 = 74 mg/kg-bw/day
Indiana bat acute LD50 mg/kg/day = 441 mg/kg/day X $(350/5.4)^{0.25}$ = 1251.29 mg/kg

Indiana bat NOAEL mg/kg-bw/day = 55 mg/kg-bw X $(350/5.4)^{0.25}$ = 156.06 mg/kg-bw
RQ for acute effects = 74/1251.29 = 0.06

RQ for chronic exposure = RQ = 74/156.06 = 0.47.

An acute RQ of 0.06 does not exceed the acute listed species LOC. A chronic RQ of 0.47 does not exceed the chronic LOC of 1.0. **Consequently, it is reasonable to make a "no effect" determination for the Indiana bat.**

Ozark Bat

The Ozark big-eared bat inhabits caves and cliffs that can be found in large blocks of forest to small forest tracts interspersed with open areas. Land use of surrounding areas does not appear to influence location of occupied maternity caves and hibernacula. The Recovery Plan indicates that the prey base for the Ozark bat consists primarily of lepidopterans and that edge habitat between forested and open areas is the preferred foraging area. Open areas allow for easy foraging because bats are not obstructed by branches while pursuing prey and are able to discriminate insects at greater distances. Based on this information, the Ozark bat cannot be precluded from foraging on agricultural fields.

Initial screening level risk assessment results for the Ozark bat were adjusted to account for the bat's biology.

Field metabolic rate kcal/day = $0.6167(7.0)^{0.862}$ = 3.30 kcal/day
(USEPA 1993, body weight of 7.0 g reflects screening assumption for the Ozark bat)
Mass of prey consumed per day = (3.30 kcal/day)/(1.7 kcal/g ww X 0.87AE)= 2.23 g/day
(1.7 is energy content of insect prey item from USEPA (1993); 0.87 is assimilation efficiency from USEPA 1993)
Mass of 2,4-D choline in insect diet = 226.56 mg/kg-ww from T-REX run
Mass of 2,4-D in daily diet = 2.23 g/day X 226.56 mg 2,4-D/kg-ww mammal prey X 0.001 = 0.51 mg/day
Daily dose in bat = 0.51 mg 2,4-D/day/0.007 mg = 72.86 mg/kg-bw/day
Ozark bat acute LD50 mg/kg/day = 441 mg/kg/day X $(350/7.0)^{(0.25)}$ = 1172.68 mg/kg
Ozark bat NOAEL mg/kg-bw/day = 55 mg/kg-bw X $(350/7.0)^{(0.25)}$ = 146.25 mg/kg-bw
RQ for acute effects = 72.86/1172.68= 0.06
RQ for chronic exposure = 72.86/146.25 = 0.50.

An acute RQ of 0.06 does not exceed the acute listed species LOC. A chronic RQ of 0.50 does not exceed the chronic LOC of 1.0. **Consequently, it is reasonable to make a "no effect" determination for the Ozark bat.**

Louisiana Black Bear

The Louisiana black bear inhabits bottomland hardwood forest communities, brackish and freshwater marshes, salt domes, wooded spoil levees along canals and bayous, and agricultural fields. Remoteness is an important spatial feature based on forest tract size and presence of roads (US FWS Recovery Plan, 1995). The Recovery Plan further describes black bears as

opportunistic omnivores with their diet being determined by food availability and season. Diet includes: grasses, sedges, invertebrates (primarily beetles, grubs, and insects), carrion, garbage, and agricultural crops (including soy and corn).

Initial screening level risk assessment results for mammals were adjusted to account for the bear's biology is as follows:

Field metabolic rate kcal/day = $0.800(92000)^{0.813}$= 8682.59 kcal/day
(USEPA 1993, body weight 92,000 g reflects screening assumption for the Louisiana black bear)
Mass of prey consumed per day = (8682.59 kcal/day)/(1.3 kcal/g ww X 0.76 AE)= 8788 g/day
(1.3 is energy content of grass item from USEPA (1993); 0.76 is assimilation efficiency from USEPA 1993)
Mass of 2,4-D in short grass diet = 578.44 mg/kg-ww from T-REX run
Mass of 2,4-D in daily diet = 8788 g/day X 578.44 mg 2,4-D/kg-ww mammal prey X 0.001 = 5083.3 mg/day
Daily dose in bear = 5083.3 mg 2,4-D/day/92 kg = 55.25 mg/kg-bw/day
Louisiana black bear LD50 mg/kg/day = 441 mg/kg/day X $(350/92000)^{(0.25)}$ = 109.52
Louisiana black bear NOAEL mg/kg-bw/day = 55 mg/kg-bw X $(350/92000)^{(0.25)}$ = 13.66 mg/kg-bw
The RQ for acute exposure = RQ = 55.24/109.52 = 0.50
The RQ for chronic exposure number = RQ = 55.25/13.66 = 4.04

An acute RQ of 0.50 exceeds the acute endangered species level of concern of 0.1. A chronic RQ of 4.04 exceeds the chronic level of concern of 1.

Bears are omnivores and are likely to eat a variety of food items. Other food item residues, as predicted from the risk assessment screen, such as for tall grass (256.12 mg 2,4-D/kg), broadleaf plants (325.7 mg 2,4-D/kg), and arthropods 226.56 mg 2,4-D/kg) would result in RQ values in excess of concern levels, but not fruits pods or seeds (36.15 mg 2,4-D/kg.

A major assumption in the screening risk assessment is that bears are coincident with the application of 2,4-D and are consuming treated materials during this period of potential maximum residue potential. Additional consideration of the biology, specifically dietary requirements of the bear in the contiguous United States, was undertaken to determine if it is reasonable to expect that exposures would occur from use in soy and corn fields. This analysis centered on two questions:

- What do bears consume over the course of the year?
- Where are home ranges established relative to sources of seasonally exploited foods?

Louisiana black bears, like most black bears, can be expected to show seasonal dietary shifts. Louisiana black bear scat analysis in a subpopulation in the Tensas River basin revealed that the

summer (June-August) and fall (September-November) diet is dominated by corn, which appears to be an anthropogenic source of seeds similar to the natural fruit and mast shift in normal bear feeding behavior (Benson and Chamberlain 2006). Scat analysis also revealed that winter (February-March) feeding was dominated by grass consumption and tree nuts, while the spring (April-May) diet is dominated by blackberry (*Rubus* sp.), grasses (including wild and wheat and oats), and sedges and beetle grubs and ants (Benson 2005). Benson reported no corn or soy in the diet of surveyed bears during the spring or summer months.

In analyzing radiotelemetry-determined home ranges for bears in the Tensas, and Deltic populations of Louisiana black bears, Benson (2005) concluded the following:

> Tensas Bears: selected winter and spring ranges encompassed swamp, and upland/lowland forested areas. Agricultural habitats were evident when choosing summer and fall home range indicating a shift in their home range closer to agricultural fields during summer and fall, presumably to exploit abundant food resources (i.e. corn).
>
> Deltic Bears: selected upland and lowland forests and avoided agriculture and corridor habitats during most seasons. Agriculture was not avoided during summer, which is likely the result of the bears moving closer to agricultural fields to exploit food resources as they become available.

To summarize, elements of the diet assessed in the screening assessment related to grasses and broadleaf foliage, and arthropod consumption would trigger risk screening concerns if exposure occurred near the time of application. The spray drift mitigations incorporated into the proposed federal action preclude exposures off the field that are above levels of concern for any taxonomic group. Therefore, the potential for exposure to occur for Louisiana black bears is limited to periods of time when available data suggest bears will actually use agricultural fields as a food source, namely summer and fall. The attractive attribute of agriculture for bears is a food source that coincides with the natural tendency of black bears to progress to consumption of fruits and mast in summer and fall. As indicated by the previously discussed scat analysis, the attraction is soybean and corn grain. Therefore, the nexus of timing and land use by bears and 2,4-D application lies with the 2,4-D residues in these seed materials at the time when bears will consume them.

The Health Effects Division summarized available corn and soybean grain residues of 2,4-D in the Human Health Risk Assessment for a Proposed Use of 2,4-D Choline on Herbicide-Tolerant Corn and Soybean (DP 389455). Based on HED's assessment, residues of 2,4-D on corn and soybean grain were non-detectable (<0.01 mg 2,4-D/kg). Likewise, residues of 2,4-D in soybean also were non-detectable (<0.01 mg 2,4-D/kg). Even considering the detection limit of 0.01 mg 2,4-D/kg, residue estimates would be orders of magnitude below the levels triggering concerns for the bear. Moreover, even if the assessment were to rely on seed residue predictions from risk screening efforts (36.16 mg 2,4-D/kg), these too would be inadequate to trigger a concern for the bear.

In summation, an effects determination extending beyond the simple screening approach to a more biologically relevant assessment representative of bear timing and food selection considered the following lines of evidence:

1. Bears are attracted to agricultural areas to exploit corn and soybean seed following a natural shift to fruits and mast in the diet from the summer to the fall.
2. Survey data show no association with agricultural fields at other times.
3. Application of 2,4-D has already occurred by the time bears are in the field and corn and soy residues are far below toxicity thresholds for the bear.
4. Estimated residues from screening level risk assessment for seeds (i.e. corn and soybean) are also below toxicity thresholds for the bear.

Consequently, it is reasonable to make a "no effect" determination for this species under prescribed conditions of the use of 2,4-D choline under this Federal action.

Birds

The screening-level assessment suggests that birds could be at risk of mortality from acute exposures to 2,4-D choline on treated fields. Of the bird species identified as potentially at risk in the screening-level assessment, three are reasonably expected to occur on treated soybean and corn fields. Therefore, species specific biological information and 2,4-D choline use patterns were considered in more depth to further refine the assessment and effects determinations for those species.

Whooping Crane

In DP 411614, an effects determination relied on effects endpoints and ingestion rates specifically tailored to the whooping crane. That analysis is directly applicable to the analysis for the species in this case as well and yields an acute RQ of 0.065.

An RQ of 0.065 does not exceed the acute listed species LOC of 0.1, **consequently it is reasonable to make a "no effect" determination for the whooping crane.**

Mississippi Sandhill Crane

Sandhill cranes are well known to feed on farms. Cranes feed on adult and larval insects, earthworms, crayfish, small reptiles, amphibians, roots, tubers, seeds, nuts, fruits and leaves. EFED considered the maximum T-REX predicted concentrations of 2,4-D choline expected to be found on arthropods as a conservative pesticide load in the prey base. Alternative terrestrial vertebrate prey are expected to have lower residues than those predicted for arthropods. A biologically representative modification to the screening assessment follows for an insect consuming crane:

Field metabolic rate kcal/day = $1.146(2500)^{0.749} = 402.01$ kcal/day

(USEPA 1993, body weight 2500 g from Dunning 1984)
Mass of prey consumed per day = 402.01 kcal/day/(1.7 kcal/g X 0.72 AE) = 328.44 g/day
(1.7 is energy content of insect prey item from USEPA (1993); 0.87 is assimilation efficiency from USEPA 1993)
Mass of 2,4-D choline in insect diet = 226.56 mg/kg-ww from T-REX run
Mass of 2,4-D in daily diet mg = (328.44 g/day X 0.001) X 226.56 mg 2,4-D/kg bird prey = 74.41 mg/day
Daily dose in crane = 74.41 mg 2,4-D/day/2.5 kg = 29.76 mg/kg-bw/day
Crane LD50 mg/kg-bw = 218.7 mg/kg-bw X $(2500/178)^{(1.15-1)}$ = 325.07 mg/kg-bw
The RQ for acute exposure = 29.76/325.07 = 0.09

An RQ of 0.09 is less than the acute listed species LOC of 0.1; **consequently a "no effect" determination is concluded for the sandhill crane.**

Lesser Prairie Chicken

Like the Louisiana black bear, the lesser prairie chicken makes use of agricultural fields at specific times of the year. However all available lines of evidence indicate the use of corn and soy is limited temporally and that the agricultural field is not an ideal habitat for the species because conversion of rangelands to cropland has reduced lesser prairie-chicken populations greatly since the early 1900's (Giesen 1998). An analysis of exposure potential for 2,4-D choline use and lesser prairie chickens centered on the seasonal use of corn and soy fields by the birds as well as the likely food consumption during those periods.

Available information suggests that the birds do not use agricultural fields during the nesting and rearing cycle. Nesting lesser prairie chickens have been observed to establish nest sites deep within native prairie habitat and similar grassland that affords adequate cover and an understory that allows the young to move. Within these areas, nesting sites are observed to be situated far from edge areas (Jamison 2000 and Hagen et al. 2007). A review of nesting and brood rearing habitat studies indicate that hens nest in tall, residual grasses or under shrubs in native pasture avoiding short grass habitats and cultivated fields and transition to habitats for rearing brood that can be described as areas with abundant bare ground and approximately 25% canopy cover of shrubs, forbs, or grasses <30 cm in height (Jamison 2000). In Jamison's review of almost a dozen studies of nesting and brood rearing habitat, corn and soy fields are not included as habitat used by the birds. Similarly, spring and summer foraging habitat has been summarized as including grasses and forbes less than 80 cm in height (Jamison 2000). In all studies of spring and summer habitat, there is no inclusion of corn or soy as a cover type utilized by the birds during nesting, brood rearing or foraging.

In contrast to the spring and summer months, the lesser prairie chicken in Finney County of southwestern Kansas has been observed commonly foraging in harvested fields of irrigated corn during fall and winter (Jamison 2000) and this pattern has been confirmed by a radiotelemetry study (Salter et al. 2005). Rob and Schroeder (2005) report similar use of soybean fields by the birds as a fall and winter source of seed and Jamison (2000) cited 17 studies reporting the use of

sorghum, corn and other grain fields as fall and winter foraging habitat in areas adjacent to prairie chicken grassland habitat. This utilization of cropland during the fall and winter months for the present grain left after harvest is further supported by Jamison et al. (2002) in their review of 25 habitat studies for the lesser prairie chicken (summarized in Appendix 3). The available information indicates that the lesser prairie chicken is attracted to corn and soy fields in the fall and winter months, where the birds exploit waste seed as an important over-wintering food source.

Based on the reports of over two dozen studies spanning multiple sites across the less prairie chicken established range, it is reasonable to expect that utilization of corn and soy by lesser prairie chickens occurs during the fall and winter months and is associated with the consumption of waste grain and seed in the fields. Consequently, the exposure refinement for the labeled 2,4-D choline product use on corn and soy should focus on the consumption of crop seeds.

Field metabolic rate kcal/day = $1.146(730)^{0.749}$ = 159.89 kcal/day (USEPA 1993, body weight
The Birds of North America, No. 364, 1998)
Mass of seed consumed per day = 159.89 kcal/day/(4.6 kcal/g X 0.59 AE) = 58.91 g/day
(4.6 is energy content of insect prey item from USEPA (1993); 0.59 is assimilation efficiency from USEPA 1993)
Mass of 2,4-D choline in seed = 36.15 mg/kg-ww from T-REX run
Mass of 2,4-D in daily diet mg = (58.91 g/day X 0.001) X 36.15 mg 2,4-D/kg bird food = 2.13 mg/day
Daily dose in chicken = (2.13 mg 2,4-D/day)/0.73 kg = 2.92 mg/kg-bw/day
Chicken LD50 mg/kg-bw = 218.7 mg/kg-bw X $(737/178)^{(1.15-1)}$ = 270.65 mg/kg-bw
The RQ for acute exposure = 2.92/270.65 = 0.01

An RQ of 0.01 does not exceed the acute listed species LOC of 0.1; **consequently it is reasonable to make a "no effect" determination for the lesser prairie chicken.**

Reptiles and Amphibians

The screening-level assessment suggests that reptiles and terrestrial-phase amphibians could be at risk of mortality from acute exposures to 2,4-D choline on treated fields. Of the 11 reptile and 4 amphibians species identified as potentially at risk in the screening-level assessment, 1 reptile is reasonably expected to occur on treated soybean and corn fields. Therefore, species specific biological information and 2,4-D choline use patterns were considered in more depth to further refine the assessment and effects determinations for that species.

Gopher Tortoise

The gopher tortoise inhabits droughty, deep sand ridges, xeric communities, originally longleaf pine-scrub oak, and may also be found along fence rows, field edges, power lines, and in pastures. The tortoise feeds on plant material, such as leaves and grass. EFED considers the maximum T-REX predicted concentrations of 2,4-D choline expected to be found on short grass

as a conservative pesticide load in the dietary items. A biologically representative modification to the screening assessment follows:

Field metabolic rate kcal/day = $0.019(4500)^{0.841}$ = 22.44 kcal/day
(USEPA 1993, body weight of 4500 g is screening assumption for the tortoise)
Mass of grass consumed per day = 22.44 kcal/day/(1.3 kcal/g X 0.47 AE) = 36.73 g/day
(1.3 is energy content of insect prey item from USEPA (1993); 0.47 is assimilation efficiency from USEPA 1993)
Mass of 2,4-D in short grass diet = 578.44 mg/kg-ww from T-REX run
Mass of 2,4-D in daily diet mg = 36.73 g/day X 578.44 mg 2,4-D/kg tortoise prey X 0.001 = 21.25 mg/day
Daily dose in tortoise = (21.25 mg 2,4-D/day)/4.5 kg = 4.72 mg/kg-bw/day

Appropriate scaling factors are not available for reptiles and amphibians so the most sensitive acute toxicity value for birds serves as a surrogate toxicity value for the tortoise:

Tortoise LD50 mg/kg-bw = 218.7 mg/kg-bw
The RQ for acute exposure = 4.72/218.7 = 0.02.

An RQ of 0.02 is less than the acute listed species LOC of 0.1; **consequently it is reasonable to make a "no effect" determination for the gopher tortoise.**

Terrestrial Invertebrates

The screening level risk assessment did not identify direct toxic effects as a concern for terrestrial invertebrates. However, because other effects were identified for taxa upon which terrestrial invertebrates may be dependent (e.g. terrestrial plants important for food and cover) an analysis of effects to listed species was included in the refined assessment of one species found to be within the action area.

American Burying Beetle

In DP 411614 a profile of habitat requirements for this species is presented and is appropriate for this assessment as well. In the previous assessment and in this case there are no direct toxicological effects to the burying beetle. The only likely indirect effect could be a reduction in cover provided by plants. The Recovery Plan (USFWS 1991) indicates that vegetative structure and soil types are unlikely to be limiting factors for the burying beetle given its broad historical geographic range. Furthermore, the apparent persistence of the beetle on Block Island suggests broad vegetation (landscape) tolerances. Given that applications of 2,4-D choline will leave the crop intact, the field is expected to maintain sufficient vegetative cover for the burying beetle. **Consequently, it is reasonable to make a "no effect" determination for the American burying beetle.**

Plants

For an herbicide, it is reasonable to expect that terrestrial plants exposed to the chemical will result in adverse effects. The proposed action has mitigation steps incorporated to eliminate exposure from concern for areas outside of the treated crops. Of the listed plants within the proposed states, only one is expected to be within the treated fields, the Spring Creek bladderpod.

Spring Creek Bladderpod

The Spring Creek bladderpod is found in northern Wilson County, Tennessee in the watersheds of Spring Creek, Bartons Creek, and Cedar Creek. It is located primarily in the floodplain, in agricultural fields, as well as pastures, glades, and disturbed areas. It is found mainly on newly disturbed sites and requires some degree of annual disturbance to complete its lifecycle (USFWS 2006).

This species is a winter annual that "germinates between September and early October, overwinters as a small rosette of leaves, and fully develops and flowers the following spring. Full sun is required for optimum growth. Flowering usually occurs in March and April. The fruit splits open upon maturity in late April and early May, and the enclosed seeds are dispersed and lie dormant until autumn," when the cycle starts over again (U.S. FWS, 2006). "If conditions are not suitable for germination the following fall, the seeds can remain dormant (but viable) for several years" (USFWS 1996).

It is likely that the species is in flowering stage when 2,4-D choline is applied to corn and soybean fields in the early season. **It is reasonable to make a "may effect, likely to adversely affect" determination for the Spring Creek bladderpod if the 2,4-D choline registration action extends to Wilson County, Tennessee.**

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Appendix 1

List of Species for Which Risk Concerns Were Identified at the Screening Level

List of Species

Animals

Acornshell, Southern (*Epioblasma othcaloogensis*)

Bat, Gray (*Myotis grisescens*)

Bat, Indiana (*Myotis sodalis*)

Bat, Ozark Big-Eared (*Corynorhinus (=plecotus) townsendii ingens*)

Bean, Cumberland (pearlymussel) (*Villosa trabalis*)

Bean, Purple (*Villosa perpurpurea*)

Bear, Louisiana Black (*Ursus americanus luteolus*)

Beetle, American Burying (*Nicrophorus americanus*)

Blossom, Green (pearlymussel) (*Epioblasma torulosa gubernaculum*)

Blossom, Tubercled (pearlymussel) (*Epioblasma torulosa torulosa*)

Blossom, Turgid (pearlymussel) (*Epioblasma turgidula*)

Blossom, Yellow (pearlymussel) (*Epioblasma florentina florentina*)

Butterfly, Karner Blue (*Lycaeides melissa samuelis*)

Cavefish, Ozark (*Amblyopsis rosae*)

Cavesnail, Tumbling Creek (*Antrobia culveri*)

Chicken, Lesser-Prairie (*Tympanuchus pallidicinctus*)

Chub, Slender (*Erimystax cahni*)

Chub, Spotfin (*Erimonax monachus*)

Clubshell (*Pleurobema clava*)

Clubshell, Black (*Pleurobema curtum*)

Clubshell, Ovate (*Pleurobema perovatum*)

Clubshell, southern (*Pleurobema decisum*)

Combshell, Cumberlandian (*Epioblasma brevidens*)

Combshell, Southern (*Epioblasma penita*)

Combshell, Upland (*Epioblasma metastriata*)

Crane, Mississippi Sandhill (*Grus canadensis pulla*)

Crane, Whooping (*Grus americana*)

Crayfish, Cave (*Cambarus aculabrum*)

Crayfish, Cave (*Cambarus zophonastes*)

Crayfish, Nashville (*Orconectes shoupi*)

Dace, Blackside (*Phoxinus cumberlandensis*)

Dace, Laurel (*Chrosomus saylori*)

Darter, Amber (*Percina antesella*)

Darter, Bayou (*Etheostoma rubrum*)

Darter, Bluemask (=jewel) (*Etheostoma sp.)*

Darter, Boulder (*Etheostoma wapiti*)

Darter, Cumberland (*Etheostoma susanae*)

Darter, Duskytail (*Etheostoma percnurum*)

Darter, Leopard (*Percina pantherina*)

Darter, Niangua (*Etheostoma nianguae*)

Darter, Slackwater (*Etheostoma boschungi*)

Darter, Snail (*Percina tanasi*)

Darter, Yellowcheek (*Etheostoma moorei*)

Dragonfly, Hine's Emerald (*Somatochlora hineana*)

Elktoe, Appalachian (*Alasmidonta raveneliana*)

Elktoe, Cumberland (*Alasmidonta atropurpurea*)

Fanshell (*Cyprogenia stegaria*)

Fatmucket, Arkansas (*Lampsilis powellii*)

Ferret, Black-Footed (*Mustela nigripes*)

Frog, Dusky Gopher (*Rana sevosa*)

Heelsplitter, Alabama (=inflated) (*Potamilus inflatus*)

Hellbender, Ozark (*Cryptobranchus alleganiensis bishopi*)

Higgins Eye (pearlymussel) (*Lampsilis higginsii*)

Kidneyshell, Fluted (*Ptychobranchus subtentum*)

Kidneyshell, Triangular (*Ptychobranchus greenii*)

Lampmussel, Alabama (*Lampsilis virescens*)

Lilliput, Pale (pearlymussel) (*Toxolasma cylindrellus*)

Logperch, Conasauga (*Percina jenkinsi*)

Lynx, Canada (*Lynx canadensis*)

Madtom, Chucky (*Noturus crypticus*)

Madtom, Neosho (*Noturus placidus*)

Madtom, Pygmy (*Noturus stanauli*)

Madtom, Smoky (*Noturus baileyi*)

Madtom, Yellowfin (*Noturus flavipinnis*)

Manatee, West Indian (*Trichechus manatus*)

Mapleleaf, Winged (*Quadrula fragosa*)

Marstonia, Royal (snail) (*Pyrgulopsis ogmorhaphe*)

Moccasinshell, Alabama (*Medionidus acutissimus*)

Moccasinshell, Coosa (*Medionidus parvulus*)

Monkeyface, Appalachian (pearlymussel) (*Quadrula sparsa*)

Monkeyface, Cumberland (pearlymussel) (*Quadrula intermedia*)

Mucket, Neosho (*Lampsilis rafinesqueana*)

Mucket, Orangenacre (*Lampsilis perovalis*)

Mucket, Pink (pearlymussel) (*Lampsilis abrupta*)

Mussel, Oyster (*Epioblasma capsaeformis*)

Mussel, Scaleshell (*Leptodea leptodon*)

Mussel, Sheepnose (*Plethobasus cyphyus*)

Mussel, Snuffbox (*Epioblasma triquetra*)

Pearlshell, Louisiana (*Margaritifera hembeli*)

Pearlymussel, Birdwing (*Lemiox rimosus*)

Pearlymussel, Cracking (*Hemistena lata*)

Pearlymussel, Curtis (*Epioblasma florentina curtisii*)

Pearlymussel, Dromedary (*Dromus dromas*)

Pearlymussel, Littlewing (*Pegias fabula*)

Pearlymussel, Slabside (*Pleuronaia dolabelloides*)

Pigtoe, Cumberland (*Pleurobema gibberum*)

Pigtoe, Finerayed (*Fusconaia cuneolus*)

Pigtoe, Flat (*Pleurobema marshalli*)

Pigtoe, Georgia (*Pleurobema hanleyianum*)

Pigtoe, Rough (*Pleurobema plenum*)

Pigtoe, Shiny (*Fusconaia cor*)

Pigtoe, Southern (*Pleurobema georgianum*)

Pimpleback, Orangefoot (pearlymussel) (*Plethobasus cooperianus*)

Plover, Piping except Great Lakes watershed (*Charadrius melodus*)

Plover, Piping Great Lakes watershed (*Charadrius melodus*)

Pocketbook, Fat (*Potamilus capax*)

Pocketbook, Ouachita Rock (*Arkansia wheeleri*)

Pocketbook, Speckled (*Lampsilis streckeri*)

Purple Cat's Paw (=Purple Cat's paw pearlymussel) (*Epioblasma obliquata obliquata*)

Rabbitsfoot (*Quadrula cylindrica cylindrica*)

Rabbitsfoot, Rough (*Quadrula cylindrica strigillata*)

Riffleshell, Tan (*Epioblasma florentina walkeri (=E. walkeri))*

Ring Pink (mussel) (*Obovaria retusa*)

Riversnail, Anthony's (*Athearnia anthonyi*)

Sawfish, Smalltooth (*Pristis pectinata*)

Sculpin, Grotto (*Cottus sp.)*

Sea Turtle, Green (*Chelonia mydas*)

Sea Turtle, Hawksbill (*Eretmochelys imbricata*)

Sea Turtle, Kemp's Ridley (*Lepidochelys kempii*)

Sea Turtle, Leatherback (*Dermochelys coriacea*)

Sea Turtle, Loggerhead Northwest Atlantic DPS (*Caretta caretta*)

Shiner, Arkansas River (*Notropis girardi*)

Shiner, Blue (*Cyprinella caerulea*)

Shiner, Topeka (*Notropis topeka (=tristis))*

Snail, Painted Snake Coiled Forest (*Anguispira picta*)

Spectaclecase (mussel) (*Cumberlandia monodonta*)

Spider, Spruce-Fir Moss (*Microhexura montivaga*)

Squirrel, Carolina Northern Flying (*Glaucomys sabrinus coloratus*)

Stirrupshell (*Quadrula stapes*)

Sturgeon, Gulf (*Acipenser oxyrinchus desotoi*)

Sturgeon, Pallid (*Scaphirhynchus albus*)

Tern, Least interior pop. (*Sterna antillarum*)

Tiger Beetle, Salt Creek (*Cicindela nevadica lincolniana*)

Tortoise, Gopher (*Gopherus polyphemus*)

Turtle, Ringed Map (*Graptemys oculifera*)

Turtle, Yellow-Blotched Map (*Graptemys flavimaculata*)

Vireo, Black-Capped (*Vireo atricapilla*)

Wartyback, White (pearlymussel) (*Plethobasus cicatricosus*)

Whale, Finback (*Balaenoptera physalus*)

Whale, Humpback (*Megaptera novaeangliae*)

Wolf, Gray (*Canis lupus*)

Woodpecker, Red-Cockaded (*Picoides borealis*)

Plants

Aster, Decurrent False (*Boltonia decurrens*)

Aster, Ruth's Golden (*Pityopsis ruthii*)

Avens, Spreading (*Geum radiatum*)

Bladderpod, Missouri (*Physaria filiformis*)

Bladderpod, Spring Creek (*Lesquerella perforata*)

Bluet, Roan Mountain (*Hedyotis purpurea* var. *montana*)

Bush-Clover, Prairie (*Lespedeza leptostachya*)

Butterfly Plant, Colorado (*Gaura neomexicana* var. *coloradensis*)

Chaffseed, American (*Schwalbea americana*)

Clover, Running Buffalo (*Trifolium stoloniferum*)

Fern, American Hart's-Tongue (*Asplenium scolopendrium* var. *americanum*)

Geocarpon minimum (No common name)

Goldenrod, Blue Ridge (*Solidago spithamaea*)

Grass, Tennessee Yellow-Eyed (*Xyris tennesseensis*)

Ground-Plum, Guthrie's (=Pyne's) (*Astragalus bibullatus*)

Harperella (*Ptilimnium nodosum*)

Ladies'-Tresses, Ute (*Spiranthes diluvialis*)

Lichen, Rock Gnome (*Gymnoderma lineare*)

Lily, Minnesota Dwarf Trout (*Erythronium propullans*)

Milkweed, Mead's (*Asclepias meadii*)

Orchid, EasternPprairie Fringed (*Platanthera leucophaea*)

Orchid, Western Prairie Fringed (*Platanthera praeclara*)

Penstemon, Blowout (*Penstemon haydenii*)

Pitcher-Plant, Green (*Sarracenia oreophila*)

Pogonia, Small Whorled (*Isotria medeoloides*)

Pondberry (*Lindera melissifolia*)

Potato-Bean, Price's (*Apios priceana*)

Prairie-Clover, Leafy (*Dalea foliosa*)

Quillwort, Louisiana (*Isoetes louisianensis*)

Rock-Cress, Braun's (*Arabis perstellata*)

Rosemary, Cumberland (*Conradina verticillata*)

Roseroot, Leedy's (*Rhodiola integrifolia ssp. leedyi*)

Sandwort, Cumberland (*Arenaria cumberlandensis*)

Skullcap, Large-Flowered (*Scutellaria montana*)

Sneezeweed, Virginia (*Helenium virginicum*)

Spiraea, Virginia (*Spiraea virginiana*)

Appendix 2

Listed Species Rationale for NO Effects When Action Area is Limited to Treated Agricultural Filed by Assumed Mitigation for Spray Drift

Species	Habitat	Rationale	Source
Animals			
Acornshell, Southern (*Epioblasma othcaloogensis*)	The southern acornshell is historically restricted to shoals in small rivers to small streams above the Fall Line. It was found on stable sand/gravel/cobble substrate in moderate to swift currents (US FWS 2000, p. 57).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	US FWS, 2000, Recovery Plan for Mobile River Basin Aquatic Ecosystem. http://ecos.fws.gov/docs/recovery_plan/001117.pdf
Bat, Gray (*Myotis grisescens*)	Gray bats are year round cave dwellers, although they may also use mines. They hibernate from as late as November 10 to late March or early April. At other times, they forage from late afternoon through early morning within 12-20 miles of their caves, most often within 4 miles of their caves. Foraging habitat is strongly correlated with open waters (rivers, lakes, reservoirs) (US FWS, 2009, pp. 6-7). Historically, rivers near caves provided both foraging habitat and riparian tree vegetation that provided cover. Small lakes and reservoirs where cover is not too distant also provide foraging habitat. Bats will opportunistically forage in riparian and upland areas, particularly when	The proposed 2,4-D choline uses are not expected to encompass caves or the forest/open water areas where bats forage.	USFWS. 1982. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/820701.pdf USFWS. 2009. 5-Year Review. http://ecos.fws.gov/docs/five_year_review/doc2625.pdf

	migrating (US FWS, 1982. pp. 6-7).		
Bean, Cumberland (pearlymussel) (*Villosa trabalis*)	Restricted typically to tributary streams of the upper reaches of the Tennessee and Cumberland Rivers. This species is most often found associated with clean, fast flowing water in stable substrate, which contains relatively firm rubble, gravel, and sand swept-free from siltation. Typically, *V. trabalis* is found buried in shallow riffle and shoal areas, often located under large rocks that must be removed by hand to inspect the habitat underneath. Ideal habitat conditions are difficult to find; much of the historical habitat for the species has likely been degraded and may be incapable of currently harboring the species (US FWS 2010, p. 7).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2010. 5 Year Review. http://ecos.fws.gov/docs/five_year_review/doc3244.pdf
Bean, Purple (*Villosa perpurpurea*)	Inhabits small headwater streams (Neves 1991) to medium-sized rivers (Gordon 1991). It is found in moderate to fast-flowing riffles with sand, gravel, and cobble substrates (Neves 1991) and rarely occurs in deep pools or slack water (Ahlstedt 1991a). It is sometimes found out of the main current adjacent to water-willow beds and under	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2004. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/040524.pdf

	flat rocks (Ahlstedt 1991a, Gordon 1991) (US FWS 2004, p. 19).		
Blossom, Green (pearlymussel) (*Epioblasma torulosa gubernaculum*)	Cumberlandian freshwater mussels are most often observed in clean, fast-flowing water in substrates that contain relatively firm rubble, gravel, and sand substrates swept free from siltation. The mussels are usually found buried in the substrate in shallow riffle and shoal areas (US FWS 1984, p. 5) The last known record for the green-blossom pearly mussel was a live individual collected in 1982 (US FWS 2007, p. 7).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1984. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/060228.pdf USFWS. 2007. 5 Year Review. http://ecos.fws.gov/docs/five_year_review/doc1961.pdf
Blossom, Tubercled (pearlymussel) (*Epioblasma torulosa torulosa*)	Occurs only in headwater tributaries of the Tennessee River (US FWS 1985, p. 11).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1985. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/850125.pdf
Blossom, Turgid (pearlymussel) (*Epioblasma turgidula*)	The last known collection of the turgid-blossom pearly mussel was a fresh-dead specimen found in the Duck River, Tennessee, in 1965 (US FWS 2007, p. 7)	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2007. 5 Year Review. http://ecos.fws.gov/docs/five_year_review/doc1961.pdf
Blossom, Yellow (pearlymussel) (*Epioblasma florentina florentina*)	The last known specimen of the yellow-blossom pearly mussel was recorded in the Little Tennessee River and Citico Creek, Tennessee in 1967 (US FWS 2007, p. 7)	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2007. 5 Year Review. http://ecos.fws.gov/docs/five_year_review/doc1961.pdf

Butterfly, Karner Blue (*Lycaeides melissa samuelis*)	Habitat is successional areas with wild lupines, such as open areas in and near forest stands, along with old fields, highway and powerline rights-of-way, and remnant barrens and savannas, having a broken or scattered tree or tall shrub canopy (US FWS, 2003. pp.28-30)	The proposed 2,4-D choline uses are not expected to overlap with successional areas with lupines or other wildflowers.	USFWS. 2003. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/030919.pdf
Cavefish, Ozark (*Amblyopsis rosae*)	Cavefish occur in groundwater habitats (the Springfield Plateau Aquifer) within Boone and Burlington Formation limestones, especially in cave streams with chert rubble substrate, and occasionally in wells and sinkholes, and even in the soil phreatic zone (Poulson, 1961, 1963; USFWS, 1986). Woods and Inger (1957) suggest cavefish dispersal occurs through phreatic cave passages. Noltie and Wicks (2001) suggests that due to shale geologic confining units, Ozark cavefish are distributed in near surface and epikarst habitats (US FWS 2011).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS 2011. Five Year Review. http://ecos.fws.gov/docs/five_year_review/doc3850.pdf

Cavesnail, Tumbling Creek (*Antrobia culveri*)	Troglobitic stream - Tumbling Creek ranges from 0.014 to 2.8 cubic meters per second (~ 0.5 to 100 cubic ft. per second); the mean annual flow is between 0.08 to 0.14 cubic meters per second (~ 3 to 5 cubic feet per second). The stream contains many chert pebbles which have been highly polished by natural abrasion within the cave. The land surface above the cave includes a variety of woodland and glade natural communities as well as pastures and/or open fields. (US FWS 2003, p. 10).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2003. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/030922a.pdf
Chub, Slender (*Erimystax cahni*)	The slender chub is restricted to the upper Tennessee River drainage in Tennessee and Virginia (US FWS 2014, p. 6)	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2014. 5 Year Review. http://ecos.fws.gov/docs/five_year_review/doc4357.pdf
Chub, Spotfin (*Erimonax monachus*)	The species is an insectivore, feeding diurnally presumably by both sight and taste in benthic areas of slow to swift current over various substrates with little siltation. Streams may range from 15-60 m in width and, where occupied, 0.3-10.0 m in depth. Water temperature in their summer habitat usually reaches greater than 20°C, and submerged macrophytes are usually absent, occasionally common. The species has been observed associated with sand,	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1983. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/831121.pdf

	gravel, rubble, boulder, and bedrock substrates (Jenkins and Burkhead, 1982) (US FWS 1983, p. 15).		
Clubshell (*Pleurobema clava*)	Clubshell is generally found in clean, coarse sand and gravel in runs, often just downstream of a riffle, and cannot tolerate mud or slackwater conditions (USFWS, 1994).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1994. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/940921.pdf
Clubshell, Black (*Pleurobema curtum*)	This species inhabits the Tombigbee River, which is a major western tributary of the Mobile Basin. It is characterized by an increasing number of sand and gravel shoals and decreasing channel size (US FWS, 1989, p. 1)	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1989. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/891114e.pdf
Clubshell, Ovate (*Pleurobema perovatum*)	Sand/gravel shoals and runs of small rivers and large streams (US FWS 2000, p. 56)	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2000. Five Year Review. http://ecos.fws.gov/docs/five_year_review/doc4153.pdf
Clubshell, Southern (*Pleurobema decisum*)	Sand/gravel shoals and runs of small rivers and large streams (US FWS 2000, p. 58)	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2000. Five Year Review. http://ecos.fws.gov/docs/five_year_review/doc4153.pdf
Combshell, Cumberlandian (*Epioblasma brevidens*)	This species inhabits medium-sized streams to large rivers on shoals and riffles in coarse, sand, gravel, cobble, and boulders. It is not associated with small stream habitats and tends not to extend as far upstream in tributaries (US FWS 2004, p. 18).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2004. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/040524.pdf
Combshell, Southern (*Epioblasma penita*)	This species inhabits the Tombigbee River, which is a major western tributary of the	The proposed 2,4-D choline uses are not expected to overlap with	USFWS. 1989. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/891114e.pdf

	Mobile Basin. It is characterized by an increasing number of sand and gravel shoals and decreasing channel size (US FWS, 1989, p. 1)	rivers, streams, creeks, or other water bodies.	
Combshell, Upland (*Epioblasma metastriata*)	Restricted to shoals in rivers and large streams above the Fall Line. It was found on stable sand/gravel/cobble substrate in moderate to swift currents (US FWS, 2000, p. 61)	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2000. Five Year Review. http://ecos.fws.gov/docs/five_year_review/doc4153.pdf
Crayfish, Cave (*Cambarus aculabrum*)	Troglobitic Stream - Along the walls of pools or along stream edges. They can be found on silt, gravel, rubble and bedrock, or even hiding underneath trash, such as an old discarded boot.; Logan Cave, Bear Hollow Cave, Elm Springs, and Old Pendergrass (US FWS 2013, p. 7).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	US FWS. 2013. Five Year Recovery. http://ecos.fws.gov/docs/five_year_review/doc4153.pdf
Crayfish, Cave (*Cambarus zophonastes*)	Troglobitic stream - muddy stream bottoms, cave stream walls, and other in-stream habitats; found in Hell Creek, Nesbitt Spring: groundwater upwelling in Town Branch... approximately 40 miles northwest of the other known sites, which are found near one another, suggesting a much wider subterranean distribution of the species. (6)	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	US FWS. Hell Creek Cave Crayfish 5-Year Review. http://ecos.fws.gov/docs/five_year_review/doc4153.pdf

Crayfish, Nashville (*Orconectes shoupi*)	Much of the stream bank is vegetated with trees and shrubs (Bouchard 1976). The Nashville crayfish has been found in a wide range of environments including gravel and cobble runs, pools with up to 10 centimeters (cm) of settled sediment, and under slabrocks and other cover (the largest crayfish are usually under cover) (USFWS 1989). The species is highly photosensitive and is usually found under cover during the day (Bouchard 1976). Canopy cover appears important, as O'Bara et al. (1985) reported that all sites they sampled had canopy cover of 60 to 90 percent. The species has been found in small pools where the flow was intermittent (Stark 1986, Miller and Hartfield 1985). Gravel-cobble substrate provides good cover for juveniles (Stark 1986, Miller and Hartfield 1985). Females seek out large slabrocks when they are carrying eggs and young. These secluded places are also needed for molting (USFWS 1989).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1989. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/890208.pdf
Dace, Blackside (*Phoxinus cumberlandensis*)	This species inhabits cool, small, upland streams with moderate flows. The fish is generally associated with undercut stream banks and large rocks,	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1988. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/880817.pdf

	and it is usually found within well-vegetated watersheds with good riparian vegetation (US FWS 1988, p. 6).		
Dace, Laurel (*Chrosomus saylori*)	This species has most often been collected from pools or slow runs from undercut banks or beneath slab-rock boulders, typically in first or second order, clear, cool, streams. Substrates typically consist of a mixture of cobble, rubble, and boulders, and the streams tend to have a dense riparian zone consisting largely of mountain laural (US FWS, 2012, p. 63606)	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2012. Federal Register Notice: Designated Critical Habitat. http://www.gpo.gov/fdsys/pkg/FR-2012-10-16/pdf/2012-24468.pdf
Darter, Amber (*Percina antesella*)	This species inhabits gentle riffle areas over sand, gravel, and cobble substrates. Aquatic vegetation that develops in riffles provides habitat for feeding and cover (US FWS, 1986, p. 6).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1986. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/860620.pdf
Darter, Bayou (*Etheostoma rubrum*)	The portion of Bayou Pierre System serving as habitat for this species is a meandering stream with stable gravel riffles or sandstone exposures (US FWS, 1990, p. 3).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1990. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/900710.pdf
Darter, Bluemask (=jewel) (*Etheostoma sp.*)	This species inhabits slow to moderate current over clean sand and fine gravel at depths of 4 to 20 inches; it typically occurs just downstream of riffles or along the margins of pools and runs (US FWS, 1997, Executive Summary).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1997. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/970725.pdf

Darter, Boulder (*Etheostoma wapiti*)	This species inhabits warm-water riverine environments and has been found only in moderate to fast current over boulder/slab rock substrate in water over 2 feet deep (US FWS, 1989, p. 2).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1989. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/890727.pdf
Darter, Cumberland (*Etheostoma susanae*)	This species inhabits pools or shallow runs of low to moderate gradient sections of streams with stable sand, silt, or sand-covered bedrock substrates (US FWS, 2012, p. 63605).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2012. Federal Register Notice: Designated Critical Habitat. http://www.gpo.gov/fdsys/pkg/FR-2012-10-16/pdf/2012-24468.pdf
Darter, Duskytail (*Etheostoma percnurum*)	This species inhabits rocky areas in gently flowing shallow pools and runs in large creeks and moderately large rivers in the Tennessee and Cumberland River Systems (US FWS, 1994, Executive Summary).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1994. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/duskytaildarter_RP.pdf
Darter, Leopard (*Percina pantherina*)	The leopard darter typically inhabits pools having predominantly rubble and boulder substrates with current velocities less than 48 centimeters/second (Jones 1984, Lechner et al. 1987). Preferred water depths are generally 20-102 cm (Jones et al. 1984; James 1989), although joint Service/U.S. Forest Service surveys over the past 10 years have observed leopard darters from depths over 4.0 meters; large to intermediate streams having relatively steep grade (US FWS 2012, p. 12).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2012. Five Year Review. http://ecos.fws.gov/docs/five_year_review/doc4107.2.12%20with%20signautres.pdf

Darter, Niangua (*Etheostoma nianguae*)	Medium sized streams of the Salem Plateau, of order 3, 4, and 5, having gradients of 3 to 21 feet/mile, elevation of stream bed =550-1050 ft, moderately clear upland creeks draining hilly topography underlain by bedrocks consisting principally of chert-bearing dolomites (US FWS 1989, pp. 9-10).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1989. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/890717.pdf
Darter, Slackwater (*Etheostoma boschungi*)	Nonbreeding habitat is small to moderately large streams. The current is usually slow, and under normal conditions, the flow ranges from still to 0.34 m/sec. In small streams, the darters show no position preference; however, in large streams they seem to confine themselves to near the banks or to undercuts in the banks. They also occur on gravel infiltrated with silt, on silt and mud, or in a combination of these. The breeding habitat is seepage water in open fields and woods (US FWS, 1984, pp. 7-8).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1984. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/840308.pdf
Darter, Snail (*Percina tanasi*)	This species occupies seven of nine tributaries of the upper Tennessee River in Alabama, Georgia and Tennessee (US FWS, 2013, p. 10).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2013. Five Year Review. http://ecos.fws.gov/docs/five_year_review/doc4136.pdf

Darter, Yellowcheek (*Etheostoma moorei*)	Devil's, Middle, South, and Archey forks of the Little Red River in Cleburne, Searcy, Stone, and Van Buren Counties... primarily within the Boston Mountains subdivision of the Ozark Plateau. Inhabits high-gradient headwater tributaries with clear water; permanent flow; moderate to strong riffles; and gravel, cobble, and boulder substrates (Robison and Buchanan 1988, p. 429) (US FWS 2012, p. 63605).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS 2012. Federal Register Notice: Designation of Critical Habitat. http://www.gpo.gov/fdsys/pkg/FR-2012-10-16/pdf/2012-24468.pdf
Dragonfly, Hine's Emerald (*Somatochlora hineana*)	The hine's emerald dragonfly occupies grass marshes and sedge meadows fed primarily by water from a mineral source or fens. Two important characteristics of the habitat appear to be groundwater-fed, shallow water slowly flowing through vegetation, and underlying dolomitic or limestone bedrock. Parts of the aquatic channels are typically covered by vegetation such as cattails or sedges. Soils can range from organic muck to mineral soils like marl. Two other important components are areas of open vegetation for foraging and forests, trees or shrubs that provide shaded areas for perching or roosting. Nearby adjacent forests may be	The proposed 2,4-D choline uses are not expected to overlap with grass marshes, sedge meadows, forested areas, or other habitat where the Hine's emerald dragonfly is expected to be found.	USFWS. 2001. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/010927.pdf

	deciduous (Illinois) or conifer (Wisconsin and Michigan). Larvae are usually found in small flowing streamlets within cattail marshes, sedge meadows, and hummocks. Places with silt, leaf litter, and decaying grasses as a substrate are often used (US FWS, 2001, p. 15-16.). Critical Habitat of 26,531 acres have been designated in Michigan, Illinois, Wisconsin, and Missouri. Almost half of this is Mackinac County, MI.		
Elktoe, Appalachian (*Alasmidonta raveneliana*)	This species has been reported from relatively shallow medium-sized creeks and rivers with cool, well-oxygenated, and moderate- to fast-flowing water. It has been observed in gravelly substrata, often mixed with cobble and boulders; in cracks in bedrock; and occasionally in relatively silt-free, coarse, sandy substrata (US FWS, 1996, Executive Summary).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1996. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/960826.pdf
Elktoe, Cumberland (*Alasmidonta atropurpurea*)	This species inhabits medium-sized rivers and may extend into headwater streams where it is often the only mussel present (Gordon and Layzer 1989, Gordon 1991). Gordon and Layzer (1989) reported that the species appears to be	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2004. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/040524.pdf

	most abundant in flats, which were described as shallow pool areas lacking the bottom contour development of typical pools, with sand and scattered cobble/boulder material, relatively shallow depths, and slow (almost imperceptible) currents. They also report the species from swifter currents and in areas with mud, sand, and gravel substrates (US FWS, 2004, p. 18).		
Fanshell (*Cyprogenia stegaria*)	The fanshell inhabits gravel substrates in medium to large rivers of the Ohio River basin (US FWS, 1991, Executive Summary).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1991. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/910709.pdf
Fatmucket, Arkansas (*Lampsilis powellii*)	Four microhabitat types that include: 1) long pools with cobble and rock as primary substrate types, 2) backwater areas downstream of peninsulas or islands covered with water willow (*Justicia americana*) and with cobble and sand as the dominant substrate, 3) slow moving pools upstream from water willow islands with sand, gravel, and cobble substrate, and 4) overflow, secondary channel pools, and tributary confluence areas with sand, cobble, and some rock substrate (US FWS 2013, p. 5)	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2013. Five Year Review. http://www.gpo.gov/fdsys/pkg/FR-2011-09-27/pdf/2011-24046.pdf
Ferret, Black-Footed (*Mustela nigripes*)	The black-footed ferret relies on prairie dog	The proposed 2,4-D choline uses are not	USFWS. 2008. 5-Year Review.

	colonies for both food and shelter.	expected to overlap with prairie dog colonies.	http://ecos.fws.gov/docs/five_year_review/doc2364.pdf
Frog, Dusky Gopher (*Rana sevosa*)	Upland sandy habitats (forest dominated by longleaf pine (Pinus palustris)), wetlands (ephemeral ponds) embedded within the forest ...Adults and subadults spend the majority of their lives underground (in gopher tortoise (Gopherus polyphemus) and mammal burrows and holes under old stumps)...During the breeding season, Mississippi gopher frogs leave their subterranean retreats in the uplands and migrate to their breeding sites during rains associated with passing cold fronts. Breeding sites are ephemeral (seasonally flooded) isolated ponds (not connected to other water bodies) located in the uplands. Both forested uplands and isolated wetlands (see further discussion of isolated wetlands in "Sites for Breeding, Reproduction, and Rearing of Offspring" section) are needed to provide space for individual and population growth and normal behavior. (US FWS 2011, p. 59777-59778)	The proposed 2,4-D choline uses are not expected to overlap with forested areas, wetlands, or ephemeral isolated ponds.	USFWS. 2011. Federal Register Notice: Designation of Critical Habitat. http://www.gpo.gov/fdsys/pkg/FR-2011-09-27/pdf/2011-24046.pdf

Heelsplitter, Alabama (=inflated) (*Potamilus inflatus*)	This species prefers a soft, stable substrate in slow to moderate currents. It has been found in sand, mud, silt and sandy-gravel, but not in large or armored gravel (US FWS, 1993, Executive Summary).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1993. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/930413.pdf
Hellbender, Ozark (*Cryptobranchus alleganiensis bishopi*)	Cool, clear streams and rivers with many large rocks. Small hellbenders hide beneath large rocks and also small stones in gravel beds. Adults spend most of their life under large, flat rocks; typically limestone or dolomite [rocks] , and in moderate to deep (less than 3 feet (ft) to 9.8 ft (less than 1 meter (m) to 3 m)), rocky, fast-flowing streams in the Ozark Plateau (Johnson 2000, p. 42; Fobes and Wilkinson 1995, pp. 5–7). In spring-fed streams, Ozark Hellbenders will often concentrate downstream of the spring, where there is little water temperature change throughout the year (US FWS 2011, p. 61956).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2011. Federal Register Notice: Listing Document. http://www.gpo.gov/fdsys/pkg/FR-2011-10-06/pdf/2011-25690.pdf
Higgins Eye (pearlymussel) (*Lampsilis higginsii*)	The higgins eye pearlymussel is characterized as an inhabitant of large rivers with loose substrates and low velocities. Many of the largest populations are in the Mississippi River, and all are in its upper drainage (US FWS, 2004, p. 7-8).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2004. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/040714.pdf

Kidneyshell, Fluted (*Ptychobranchus subtentum*)	Associated with the Cumberland and Tennessee River drainages. Generally live embedded in the bottom of stable streams and other bodies of water, and within riffle areas of sufficient current velocities to remove finer sediments and provide well oxygenated waters (US FWS, 2013, p. 59560)	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2013. Federal Register Notice: Designation of Critical Habitat. http://www.gpo.gov/fdsys/pkg/FR-2013-09-26/pdf/2013-23357.pdf
Kidneyshell, Triangular (*Ptychobranchus greenii*)	Sand/gravel shoals and runs ofsmall rivers and large streams (US FWS 2000, p. 60)	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2000. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/850702.pdf
Lampmussel, Alabama (*Lampsilis virescens*)	This species inhabits sand and gravel substrates in small to medium sized streams (US FWS, 1985, p. 9).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1985. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/850702.pdf
Lilliput, Pale (pearlymussel) (*Toxolasma cylindrellus*)	This species is observed in clean, fast-flowing water in substrates that contain relatively firm rubble, gravel, and sand substrates swept free from siltation. These mussels are usually found buried in the substrate in shallow riffle and shoal areas (US FWS, 1984, p. 5).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1984. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/840822.pdf
Logperch, Conasauga (*Percina jenkinsi*)	This species has been collected in deep shuts and flowing pools with clear, clean gravel and mixed rubble substrates in areas with moderate to swift currents (US FWS, 1986, p. 8).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1986. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/860620.pdf
Madtom, Chucky (*Noturus crypticus*)	This species has been found in stream runs with slow to moderate current over pea gravel, cobble, or slab-rock	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2012. Federal Register Notice: Designation of Critical Habitat.

	boulder substrates (US FWS, 2012, p. 63606)		http://www.gpo.gov/fdsys/pkg/FR-2012-10-16/pdf/2012-24468.pdf
Madtom, Neosho (*Noturus placidus*)	Benthic species ... inhabits shallow gravel substrates. The species remains primarily inactive and hidden in bottom substrate during the day, and comes out at night to forage for aquatic invertebrates (Moss 1981). The majority of Neosho madtom collections are from areas with gravel substrates, primarily gravel in the size range of 0.5 to 2.5 inches (12 – 64 mm) in diameter. Most collections are made in the Spring and Neosho Rivers in shallow water, generally less than three feet deep (<1 m). Within these systems, no significant differences in madtom preferences for depth, velocity, and substrate size were found but gravel riffles with currents of one to four feet per second (<1.25 m/sec.) are preferred by adults (Moss 1981; Fuselier and Edds 1994; Wildhaber et al. 2000a) (US FWS 2013, pp. 6).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2013. Five Year Review. http://ecos.fws.gov/docs/five_year_review/doc4140.pdf
Madtom, Pygmy (*Noturus stanauli*)	This species inhabits shallow shoals, where the current is moderate to strong and where there is pea-sized gravel or fine sand substrates, in moderately large rivers of the Tennessee River system (US FWS, 1994, Executive Summary).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1994. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/940927a.pdf

Madtom, Smoky (*Noturus baileyi*)	This species is restricted to Citico Creek, primarily within the Cherokee National Forest, Monroe County, Tennessee (US FWS, 1985,p. 1)	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1985. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/060313b.pdf
Madtom, Yellowfin (*Noturus flavipinnis*)	This species prefers pool habitats beneath cobble and small boulder substrates (Miller 2011). The strongest habitat models identified preferred pools for yellowfin madtoms as greater than 40 meters in length with gravel being the main substrate beneath cover rocks (Miller 2011). (US FWS, 2012, p. 16).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2012. Five Year Review. http://ecos.fws.gov/docs/five_year_review/doc4146.pdf
Manatee, West Indian (*Trichechus manatus*)	This species lives in freshwater, brackish and marine habitats (US FWS, 2001, Executive Summary).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	US FWS. 2001. Recovery Plan- Third Revision. http://ecos.fws.gov/docs/recovery_plan/011030.pdf
Mapleleaf, Winged (*Quadrula fragosa*)	The general habitat is poorly known, although it has been characterized as a large stream species. It has been collected on mud, mud-covered gravel, and gravel substrates. In its current location in the St. Croix River, it occurs in riffles with clean gravel, sand, or rubbles substrates and fast current. It was not found in a natural impoundment of the river (US FWS, 1997, p. 5-6).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1997. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/970625.pdf
Marstonia, Royal (snail) (*Pyrgulopsis ogmorhaphe*)	This species is found in Blue Spring, which is in the water supply for the town of Jasper, Tennessee, and downstream to the State	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1995. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/950811.pdf

	Highway 64 bridge (US FWS, 1995, Executive Summary).		
Moccasinshell, Alabama (*Medionidus acutissimus*)	Inhabits sand/gravel/cobble shoals with moderate to strong currents in streams and small rivers. (US FWS 2000, p. 51)	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2000. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/001117.pdf
Moccasinshell, Coosa (*Medionidus parvulus*)	Inhabits sand/gravel/cobble shoals with moderate to strong currents in streams and small rivers. (US FWS 2000, p. 52)	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2000. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/001117.pdf
Monkeyface, Appalachian (pearlymussel) (*Quadrula sparsa*)	This species is most often observed in clean-fast-flowing water in substrates that contain relatively firm rubble, gravel, and sand substrates swept free from siltation. These mussels are usually found buried in the substrate in shallow riffle and shoal areas (US FWS, 1984, p. 7).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1984. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/840709.pdf
Monkeyface, Cumberland (pearlymussel) (*Quadrula intermedia*)	This species is most often observed in clean-fast-flowing water in substrates that contain relatively firm rubble, gravel, and sand substrates swept free from siltation. These mussels are usually found buried in the substrate in shallow riffle and shoal areas (US FWS, 1984, p. 9).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1984. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/840709b.pdf

Mucket, Neosho (*Lampsilis rafinesqueana*)	The Neosho mucket is associated with shallow riffles and runs comprising gravel substrate and moderate to swift currents. The species is most often found in areas with swift current, but in Shoal Creek and the Illinois River it prefers near-shore areas or areas out of the main current (Oesch 1984, p. 221; Obermeyer 2000, pp. 15–16) (US FWS 2012, p. 63443).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2012. Federal Register Notice: Proposed Listing Document. http://www.gpo.gov/fdsys/pkg/FR-2012-10-16/pdf/2012-24151.pdf
Mucket, Orangenacre (*Lampsilis perovalis*)	Currently restricted to high quality stream and small river habitat, the species is found on stable sand/gravel/cobble substrate in moderate to swift currents (US FWS 2000, p. 55)	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2000. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/001117.pdf
Mucket, Pink (pearlymussel) (*Lampsilis abrupta*)	The pink mucket may still exist in stretches of the lower Ohio River (US FWS, 1985, p. 10). The pink mucket habitat is large rivers at least 60 feet wide, where it occurs at depths up to 25 feet deep. Currents are typically moderate to fast and substrates range from silt to boulders, rubble, gravel, and sand (US FWS, 1985, p. 11). The species seems to have adapted to living in impounded waters, at least in the upper reaches where the water is flowing (US FWS, 1985, p. 10).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1985. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/pink%20mucket%20rp.pdf

Mussel, Oyster (*Epioblasma capsaeformis*)	This species is generally adapted to live in the gravel shoals of free-flowing rivers and streams (US FWS, 2004, Executive Summary).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2004. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/040524.pdf
Mussel, Scaleshell (*Leptodea leptodon*)	The scaleshell habitat is composed of riffles and runs in medium to large rivers with low to medium gradients and slow to moderate velocity of current. It inhabits a variety of substrates from gravel to mud, but riffles are primarily stable (US FWS, 2010, p.18).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2012. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/100407_v2.pdf
Mussel, Sheepnose (*Plethobasus cyphyus*)	The sheepnose is a larger-stream species occurring primarily in shallow shoal habitats with moderate to swift currents over coarse sand and gravel. Habitats with sheepnose may also have mud, cobble, and boulders. Sheepnose in larger rivers may occur at depths exceeding 6 m (US FWS, 2012, p 14916).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2012. Federal Register Notice: Final Rule. http://www.gpo.gov/fdsys/pkg/FR-2012-03-13/pdf/2012-5603.pdf
Mussel, Snuffbox (*Epioblasma triquetra*)	The habitat is described as swift currents and riffles, and shoals and wave-washed shores of lakes over gravel and sand with occasional cobble and boulders. They generally burrow deep into the substrate (US FWS, 2010, p 67554). This constitutes a wide diversity of habitats. However, they do not occur in impounded areas or reservoirs	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2010. Federal Register Notice: Listing. http://www.gpo.gov/fdsys/pkg/FR-2010-11-02/pdf/2010-27413.pdf#page=2 USFWS. 2012. Federal Register Notice: Final Rule. http://www.gpo.gov/fdsys/pkg/FR-2012-02-14/pdf/2012-2940.pdf

	(except tailwaters) (US FWS, 2012, p 8652).		
Pearlshell, Louisiana (*Margaritifera hembeli*)	Specific habitat requirements are not known. This species apparently requires a free-flowing stream (US FWS, 1990, Executive Summary).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1990. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/901203.pdf
Pearlymussel, Birdwing (*Lemiox rimosus*)	This species is most often observed in clean fast-flowing water in substrates that contain relatively firm rubble, gravel and sand substrates swept free from siltation. It is usually found buried in the substrate in shallow riffle and shoal areas (US FWS, 1984, p. 6).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1984. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/060206a.pdf
Pearlymussel, Cracking (*Hemistena lata*)	The cracking pearlymussel has undergone a substantial range reduction. It was historically distributed in the Ohio, Cumberland, and Tennessee River systems. The species has been extirpated throughout much of its range. It was last collected from Mussel Shoals, an 85 km reach of the Tennessee River in Alabama, prior to 1925 and is presumed to be extirpated from the shoal. It is presently known to survive at only a few shoals in the Clinch and Powell Rivers in Tennessee and Virginia, and it has likely been reduced to only three viable populations in these systems. The species possibly survives in the	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	http://ecos.fws.gov/docs/life_histories/F01X.html

	Green River, Kentucky, and below Pickwick Reservoir in the Tennessee River, Tennessee as well		
Pearlymussel, Curtis (*Epioblasma florentina curtisii*)	The Curtis' pearlymussel has not been seen alive in over a decade. Limited to stream segments that are transitional between headwater and lowland streams reaches - shallow stable riffles (US FWS 2010, p. 3, 7).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2010. Five Year Review. http://ecos.fws.gov/docs/recovery_plan/840709c.pdf
Pearlymussel, Dromedary (*Dromus dromas*)	This species is most often observed in clean, fast-flowing water in substrates that contain relatively firm rubble, gravel and sand substrates swept free from siltation. These mussels are usually found buried in the substrate in shallow riffle and shoal areas (US FWS, 1984, p. 8).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1984. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/840709c.pdf
Pearlymussel, Littlewing (*Pegias fabula*)	This species inhabits small to medium, low turbidity, cool-water, high to moderate gradient streams in the Cumberland and Tennessee River basins (US FWS, 1989, p. 5).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1989. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/890922.pdf
Pearlymussel, Slabside (*Pleuronaia dolabelloides*)	Associated with the Cumberland and Tennessee River drainages. Generally live embedded in the bottom of stable streams and other bodies of water, and within riffle areas of sufficient current velocities to remove finer sediments and provide well	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2013. Federal Register Notice: Designation of Critical Habitat. http://www.gpo.gov/fdsys/pkg/FR-2013-09-26/pdf/2013-23357.pdf

	oxygenated waters (US FWS, 2013, p. 59560)		
Pigtoe, Cumberland (*Pleurobema gibberum*)	This species inhabits medium-sized rivers with fast-flowing water in areas with predominately gravel, sand and cobble substratum (US FWS, 1992, Executive Summary).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1992. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/920813.pdf
Pigtoe, Finerayed (*Fusconaia cuneolus*)	This species is typically a riffle species that inhabits ford and shoal areas in free-flowing streams of moderate gradient (US FWS, 1984, p. 7).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1984. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/fine%20rayed%20recov%20plan.pdf
Pigtoe, Flat (*Pleurobema marshalli*)	Habitat is the Tombigbee River, characterized by an increasing number of sand and gravel shoals and decreasing channel size in the upper portions (US FWS, 1989).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1989. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/891114e.pdf
Pigtoe, Georgia (*Pleurobema hanleyianum*)	This species requires flowing water, sable stream channels with minimal sediment and algae growth, and adequate water quality. It also requires a host fish, which is currently unknown (US FWS, 2013, Executive Summary).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2013. Draft Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/Hartfield%20and%20Powell%202013%20Draft%20Three%20Mollusks%20RP%20062813.pdf
Pigtoe, Rough (*Pleurobema plenum*)	The rough pigtoe habitat is medium to large rivers, 60 feet or wider, in sand and gravel substrates. Very limited collection information suggests it occurs below spillways, in transition zones, and in sand and gravel substrates (US FWS, 1984, p. 8).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1984. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/840806.pdf

Pigtoe, Shiny (*Fusconaia cor*)	This species is typically a riffle species, found along fords and shoals of clear, moderate to fast-flowing streams and rivers with stable substrate. It does not inhabit deep pools or impounded areas. This species is usually found well-buried in the substrate during most of the year and is more readily visible in early summer (US FWS, 1984, p. 8).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1984. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/840709d.pdf
Pigtoe, Southern (*Pleurobema georgianum*)	Sand/gravel shoals and runs of small rivers and large streams (US FWS 2000, p. 59)	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2000. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/001117.pdf
Pimpleback, Orangefoot (pearlymussel) (*Plethobasus cooperianus*)	The 1984 Recovery Plan indicated that the orange-foot pimpleback was known from the Tennessee, Cumberland, and lower Ohio Rivers (US FWS, 1984. p. 2). The habitat is described as medium to large rivers in sand and gravel substrates. In the Ohio River it was collected from 15-29 feet depths, but may have lived in shallower riffles (US FWS, 1984, p. 6).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1984. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/840930b.pdf

Plover, Piping except Great Lakes watershed (*Charadrius melodus*)	The northern Great Plains DPS of the piping plover utilizes four types of habitats for breeding: alkali lakes and wetlands, inland lakes (Lake of the Woods), reservoirs, and rivers. Most breeding occurs along alkali lakes and wetlands, where nesting sites are generally wide, gravelly, salt encrusted beaches with minimal vegetation . At inland lakes, they use barren to sparsely vegetated islands, beaches, and peninsulas. Sparsely vegetated sandbars and reservoir shorelines are preferred in riverine systems (US FWS, 2002, p. 57640).	The proposed 2,4-D choline uses are not expected to overlap with shorelines, beaches, and sandbars of rivers and alkali wetlands.	USFWS. 2002. Federal Register Notice. http://ecos.fws.gov/docs/federal_register/fr3943.pdf
Plover, Piping Great Lakes watershed (*Charadrius melodus*)	The breeding habitat of the Great Lakes DPS of the piping plover is well defined by the Critical Habitat designation. Critical Habitat for this DPS consists of approximately 200 miles of Great Lakes shoreline (extending 1640 ft inland) in 26 counties in Minnesota, Wisconsin, Michigan, Illinois, Indiana, Ohio, Pennsylvania, and New York. Additional Critical Habitat for wintering populations of this DPS are in the southeastern United States and other areas that are outside the scope of this analysis (USFWS, 2000; USFWS, 2009, p.2).	The proposed 2,4-D choline uses are not expected to overlap with sparsely vegetated sandy shorelines or islands of the Great Lakes.	USFWS. 2009. 5-Year Review. http://ecos.fws.gov/docs/five_year_review/doc3009.pdf USFWS. 2000. Federal Register Notice http://ecos.fws.gov/docs/federal_register/fr3648.pdf

Pocketbook, Fat (*Potamilus capax*)	The fat pocketbook is a large river species requiring flowing water and a stable substrate, which can vary widely but is most likely a mixture of sand, silt and clay. It occurs in water from a few inches deep to at least 8 feet. Habitat includes drainage ditches. (US FWS, 1989, p. 6). Populations have been found in larger rivers in the Ohio River system, and it may occur as deep as 20 feet (US FWS, 2012, p. 7-8). It can also tolerate periods of high suspended sediments (US FWS, 2012, p. 11).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1989. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/891114c.pdf USFWS. 2012. Five Year Review. http://ecos.fws.gov/docs/recovery_plan/891114c.pdf
Pocketbook, Ouachita Rock (*Arkansia wheeleri*)	This species inhabits pools, backwaters, and side channels of rivers and large creeks in or near the southern slope of the Ouachita Uplift. This species occupies stable substrates containing gravel, sand, and other materials (US FWS, 2004. Executive Summary).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2004. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/040602.pdf
Pocketbook, Speckled (*Lampsilis streckeri*)	Specific habitat requirements are not known. The species is found in coarse to muddy sand in depths up to 0.4 meters (1.3 feet) with a constant flow of water. The occurrence in areas of constant water flow suggests a requirement for well-oxygenated conditions (US FWS 1992, p. 3).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1992. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/920102.pdf

Purple Cat's Paw (=Purple Cat's paw pearlymussel) (*Epioblasma obliquata obliquata*)	Inhabits boulder to sandy substrates in large rivers of the Ohio River basin (US FWS 1992, Executive summary).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1992. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/920310.pdf
Rabbitsfoot (*Quadrula cylindrica cylindrica*)	"Rabbits foot is primarily an inhabitant of small to medium sized streams and some larger rivers. It usually occurs in shallow water areas along the bank and adjacent runs and shoals with reduced water velocity." They have been reported in deep water runs up to 12 feet depth. "Bottom substrates generally include gravel and sand" (US FWS, 2012, p. 63446).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2012. Federal Register Notice. http://www.gpo.gov/fdsys/pkg/FR-2012-10-16/pdf/2012-24151.pdf
Rabbitsfoot, Rough (*Quadrula cylindrica strigillata*)	Inhabits medium-sized to large rivers in moderate to swift current but often exists in areas close to, but not in, the swiftest current (Gordon 1991). It is reported to live in silt, sand, gravel, or cobble in eddies at the edge of midstream currents and may be associated with macrophyte beds (Yeager and Neves 1986, Gordon 1991). The rough rabbitsfoot seldom burrows; it generally lies on its side on the stream bottom (Neves, pers. comm., 2003) (US FWS 2004, p. 19).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	FWS. 2004. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/040524.pdf
Riffleshell, Tan (*Epioblasma florentina walkeri (=E. walkeri)*)	This species inhabits streams described as shallow and turbid with numerous riffles and substrate consisting of	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1984. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/tan%20riffleshell%20rp.pdf

	loose rocks and gravel bars with an abundance of water willow (US FWS, 1984. P, 7).		
Ring Pink (mussel) (*Obovaria retusa*)	This species inhabits gravel and sandy substrates in large rivers of the Ohio River basin (US FWS, 1991).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1991. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/910325.pdf
Riversnail, Anthony's (*Athearnia anthonyi*)	This species is typically found in large streams on large submerged objects (e.g., rocks and logs) or gravelly substrata in relatively shallow, moderately to fast-flowing water (US FWS, 1997).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1997. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/970813.pdf
Sawfish, Smalltooth (*Pristis pectinata*)	Smalltooth sawfish are tropical marine and estuarine fish that have the northwestern terminus of their Atlantic range in the waters of the eastern United States. In the United States, smalltooth sawfish are generally a shallow water fish of inshore bars, mangrove edges, and seagrass beds, but are occasionally found in deeper coastal waters. (US FWS NMFS, NOAA 2001, p. 19416)	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	NMFS, NOAA. 2001. Federal Register Notice: Proposed Endangered Status for a DPS of Smalltooth Sawfish. http://ecos.fws.gov/docs/federal_register/fr3741.pdf
Sculpin, Grotto (*Cottus sp.*)	Grotto sculpin occupy cave streams, resurgences (also known as "spring branches") (Vandike 1985, p. 10), springs, and surface streams (Adams 2012, pers. comm.; Adams et al. 2013, pp. 491–493; Burr et al. 2001, p. 284). They occupy pools and riffles with	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2013. Federal Register Notice: Designation of Critical Habitat (58928) http://www.gpo.gov/fdsys/pkg/FR-2013-09-25/pdf/2013-23182.pdf

	moderate flows and variable depths (4 to 33 centimeters (cm) (1.6 to 13 in)) (Burr et al. 2001, p. 284). Although grotto sculpin have been documented to occur over a variety of substrates (for example, silt, gravel, cobble, rock rubble, and bedrock), the presence of cobble or pebble is necessary for spawning (Burr et al. 2001, p. 284; Adams et al. unpub. data; Adams et al. 2013, pp. 491–492) (US FWS 2013, p. 58928).		
Sea Turtle, Green (*Chelonia mydas*)	Green turtles are primarily restricted to tropical and subtropical waters. In U.S. Atlantic and Gulf of Mexico waters, green turtles are found from Massachusetts to Texas and in the U.S. Virgin Islands and Puerto Rico. Seagrasses are the principal dietary component of juvenile and adult green turtles throughout the Wider Caribbean region (Bjorndal, 1995). (NMFS, NOAA 1998, p. 46694)	The proposed 2,4-D choline uses are not expected to overlap with coastal waters.	NMFS, NOAA. 1998. Federal Register Notice: Designated critical habitat. http://ecos.fws.gov/docs/federal_register/fr3295.pdf
Sea Turtle, Hawksbill (*Eretmochelys imbricata*)	The hawksbill turtle occurs in tropical and subtropical waters of the Atlantic, Pacific, and Indian Oceans. Coral reefs, like those found in the waters surrounding Mona and Monito Islands, are widely recognized as the primary foraging habitat of juvenile, subadult, and adult	The proposed 2,4-D choline uses are not expected to overlap with coastal waters.	NMFS, NOAA. 1998. Federal Register Notice: Designated critical habitat. http://ecos.fws.gov/docs/federal_register/fr3295.pdf

	hawksbill turtles. This habitat association is directly related to the species' highly specific diet of sponges (Meylan, 1988). Hawksbills depend on coral reefs for food and shelter; therefore, the condition of reefs directly affects the hawksbill's well-being. (NMFS, NOAA 1998, p. 46695)		
Sea Turtle, Kemp's Ridley (*Lepidochelys kempii*)	This life history pattern is characterized by three Basic ecosystem zones: (1) Terrestrial zone (supralittoral) - the nesting beach where both oviposition and embryonic development occur; (2) Neritic zone - the nearshore (including bays and sounds) marine environment (from the surface to the sea floor) where water depths do not exceed 200 meters, including the continental shelf; and (3) Oceanic zone - the vast open ocean environment (from the surface to the sea floor) where water depths are greater than 200 meters. (NMFS, NOAA 2011, p. I-8)	The proposed 2,4-D choline uses are not expected to overlap with coastal waters.	NMFS, NOAA. 2011. Bi-national recovery plan for the kemp's ridley sea turtle. http://ecos.fws.gov/docs/recovery_plan/090116.pdf
Sea Turtle, Leatherback (*Dermochelys coriacea*)	Leatherbacks are able to take advantage of a wide variety of marine ecosystems (reviewed by Saba 2013; see NOAA large marine ecosystem website: http://www.lme.noaa.gov/). Within these ecosystems, various oceanic features such as water temperature,	The proposed 2,4-D choline uses are not expected to overlap with coastal waters.	NMFS, NOAA. 2013. Five Year Review. http://ecos.fws.gov/docs/recovery_plan/090116.pdf

	downwelling, Ekman upwelling, sea surface height, chlorophyll-a concentration, and mesoscale eddies affect the presence of leatherbacks (Bailey et al. 2013; Benson et al. 2011). The physical characteristics observed within these marine ecosystems also affect the distribution and abundance of leatherback prey (reviewed by Saba 2013). (NFMS, NOAA 2013, p. 20-22)		
Sea Turtle, Loggerhead Northwest Atlantic DPS (*Caretta caretta*)	The three basic ecosystems in which loggerheads live are the: 1. Terrestrial zone (supralittoral) - the nesting beach where both oviposition (egg laying) and embryonic development and hatching occur. 2. Neritic zone - the nearshore marine environment (from the surface to the sea floor) where water depths do not exceed 200 meters. The neritic zone generally includes the continental shelf, but in areas where the continental shelf is very narrow or nonexistent, the neritic zone conventionally extends to areas where water depths are less than 200 meters. 3. Oceanic zone - the vast open ocean environment (from the surface to the sea floor) where water depths are	The proposed 2,4-D choline uses are not expected to overlap with coastal waters.	NMFS, NOAA, 2009, Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/090116.pdf

	greater than 200 meters. (NMFS, NOAA 2009, p. I-20)		
Shiner, Arkansas River (*Notropis girardi*)	Wilde et al. (2000) found no obvious selection for or avoidance of any particular habitat type (i.e., main channel, side channel, backwaters, and pools) by Arkansas River shiner. Arkansas River shiners did tend to select side channels and backwaters slightly more than expected based on the availability of these habitats (Wilde et al. 2000). Likewise, they appeared to make no obvious selection for, or avoidance of, any particular substrate type. Substrates (i.e., the river bed) in the Canadian River in New Mexico and Texas were predominantly sand, however, the Arkansas River shiner was observed to occur over silt slightly more than expected based on the availability of this substrate (Wilde et al. 2000) ; preferred habitat for the Arkansas River shiner is the mainstem of larger plains rivers... historically inhabited the main channels of wide, shallow, sandy-bottomed rivers and larger streams of the Arkansas River basin (Gilbert 1980). Adults are uncommon in quiet	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	US FWS. 2005. Federal Register Notice: Designation of Critical Habitat. http://ecos.fws.gov/docs/recovery_plan/950830.pdf

	pools or backwaters lacking streamflow, and almost never occurred in habitats having deep water and bottoms of mud or stone (Cross 1967) (US FWS 2005).		
Shiner, Blue (*Cyprinella caerulea*)	The blue shiner primarily occupies second to fourth order, moderate gradient streams within the Ridge and Valley and Piedmont physiographic provinces of Alabama, Georgia, and Tennessee (Smith-Vaniz 1968, Ramsey 1976, Krotzer 1984, Ramsey and Pierson 1986, Pierson and Krotzer 1987, Mayden 1989, Pierson et al. 1989, Boschung 1992, Etnier and Starnes 1993, Dobson 1994). Most watersheds where it is found are predominately forested, and agriculture and urban development are minimal. For example in Alabama, land cover in the Choccolocco watershed is 66 percent forest, 20 percent pasture, and 13 percent agriculture. It prefers a sand or sand and gravel substrate sometimes with cobble, low to moderate velocity current, and a depth of about 0.15 to 1 meters (0.5 to 3 feet) (Gilbert et al. 1979; Krotzer 1984, Pierson and Krotzer 1987, Dobson 1994) (US FWS 1995, p. 3-4)	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	US FWS. 1995. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/950830.pdf

Shiner, Topeka (*Notropis topeka (=tristis)*)	Topeka shiners are typically found in small, low order, prairie streams with good water quality, relatively cool temperatures, and low fish diversity. Although Topeka shiners can tolerate a range of water temperatures, cooler, spring-maintained systems are considered optimal. These streams generally maintain perennial flow but may become intermittent during summer or periods of drought, as long as there are refuge areas in headwaters springs or main channels of larger streams that do not provide adequate year-round habitat. While headwaters, oxbows and side channels provide the typical habitat, mainstem streams provide for dispersal as well as for drought refuge. The shiner is very often associated with groundwater discharges. Substrates are typically clean gravel, cobble, or sand, but may include bedrock and clay hardpan covered by a thin layer of silt, or coarse sand overlain by silt and detritus. Spawning is often over native sunfish nests (US FWS, 2004, pp, 44743-4).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2004. Federal Register Notice: Designation of Critical Habitat. http://ecos.fws.gov/docs/five_year_review/doc2585.pdf

Snail, Painted Snake Coiled Forest (*Anguispira picta*)	This species is limited to Buck Creek Cove. It is found only in limestone outcrops in parts of the cove with good cover. The slopes of the cove are very steep with crock outcrops and sheer cliffs at intervals along both sides of the creek (US FWS, 1982).	The proposed 2,4-D choline uses are not expected to overlap with creeks or stone outcrops along creeks.	USFWS. 1982. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/060206.pdf
Spectaclecase (mussel) (*Cumberlandia monodonta*)	The spectaclecase generally inhabits large rivers where it occurs in microhabitats sheltered from the main force of current. It occurs in a variety of substrates from mud and sand to gravel, cobble, and boulders in relatively shallow riffles and shoals with a slow to swift current. It is most often found in firm mud between large rocks in quiet water very near the interface with swift currents (US FWS, 2012, p 14916).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2012. Federal Register Notice: Final Rule. http://www.gpo.gov/fdsys/pkg/FR-2012-03-13/pdf/2012-5603.pdf
Spider, Spruce-Fir Moss (*Microhexura montivaga*)	typical habitat appears to be associated with moist, well-drained moss mats growing on rocks and boulders in well-shaded situations in mature high-elevation conifer forests dominated by Fraser fir, Abiesfraseri, often with scattered red spruce, *Picea rubens*. (US FWS 1998, p. iii)	The proposed 2,4-D choline uses are not expected to overlap with high-elevation conifer forests.	US FWS, 1998, Recovery Plan for the Spruce-fir Moss Spider http://www.gpo.gov/fdsys/pkg/FR-2011-09-27/pdf/2011-24046.pdf

Squirrel, Carolina Northern Flying (*Glaucomys sabrinus coloratus*)	Species composition of the occupied forest may vary in different locations, some combination of hardwoods and conifers (particularly spruce and fir) appears essential to support these animals. Food sources for the Carolina northern flying squirrel include fungi, lichens, staminate cones, insects, and other animal matter (US FWS 1990, p. 6-7)	The proposed 2,4-D choline uses are not expected to overlap with hardwood and conifer forests.	USFWS. 1990. Recovery Plan for Appalachian Northern Flying Squirrels. United States Fish and Wildlife Service.
Stirrupshell (*Quadrula stapes*)	Habitat is the Tombigbee River, characterized by an increasing number of sand and gravel shoals and decreasing channel size in the upper portions (US FWS, 1989).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1989. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/891114e.pdf
Sturgeon, Gulf (*Acipenser oxyrinchus desotoi*)	The Gulf sturgeon is an Anadromous fish which migrates from salt water into large coastal rivers to spawn and spend the warm months. The majority of its life is spent in fresh water (US FWS, 1995).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1995. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/950922.pdf
Sturgeon, Pallid (*Scaphirhynchus albus*)	Habitat is the bottom in swift waters of large, turbid, free-flowing rivers, often over sand substrates, but other substrates include at least gravel and rock. Sloughs, chutes, and side channels that transition from floodplain to the main channels are apparently important as spawning, nursery, and feeding areas. Within the subject states, this habitat occurs in the	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 2014. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/Pallid%20Sturgeon%20Recovery%20Plan%20First%20Revision%20signed%20version%20012914_3.pdf USFWS. 2007. Five Year Review. http://ecos.fws.gov/docs/five_year_review/doc1059.pdf

	Mississippi and Missouri rivers (US FWS, 1993, pp 6-7). Within this habitat, they tend to select main channel habitats in the Mississippi River, and main channel habitats with islands or sand bars in the upper Missouri River (US FWS, 2007. p. 8). They do not typically occur in impounded areas due to lower flows and other hydrologic factors, nor where channel stabilization has reduced channel meandering and access to floodplain areas (US FWS, 2007, p. 38).		
Tern, Least interior pop. (*Sterna antillarum*)	Species is a piscivore, feeding in shallow waters of rivers, streams (USFWS, 1990, p. 20). Beaches, sand pits, sandbars, islands and peninsulas are the principal breeding habitats of coastal areas and nesting can be close to water but is usually between the dune environment and the high tide line. Vegetation at coastal nesting areas is sparse, scattered and short. Riverine nesting areas are sparsely vegetated sand and gravel bars within a wide unobstructed river channel, or salt flats along lake shorelines. Nesting occurs along river banks (US FWS, 1990, p. 20).	The proposed 2,4-D choline uses are not expected to overlap with riparian areas, including coastal areas.	USFWS. 1990. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/900919a.pdf

Tiger Beetle, Salt Creek (*Cicindela nevadica lincolniana*)	Very specific habitat requirements and occurs in saline wetlands—on exposed saline mud flats or along mud banks of streams and seeps that contain salt deposits and are sparsely vegetated (Carter 1989; Spomer and Higley 1993; LaGrange 1997; Spomer et al. 2004a). Larvae have been found only on moist salt flats and salt-encrusted banks of Little Salt Creek in northern Lancaster County (Spomer et al. 2004a) and saline wetlands associated with Rock Creek in the southern margin of Saunders County. Salt Creek tiger beetles require open, barren salt flat areas (US FWS 2009, p. 2).	The proposed 2,4-D choline uses are not expected to overlap with wetlands.	US FWS, 2009, Recovery Outline for the Salt Creek tiger beetle (2)
Turtle, Ringed Map (*Graptemys oculifera*)	Rivers and adjacent white sand beaches with basking sites (brush, logs debris) (USACE)	The proposed 2,4-D choline uses are not expected to overlap with rivers or beaches.	USACE. Ringed Map Turtle Species Profile. US Army Corps of Engineers, Engineer Research and Development Center, Environmental Laboratory.
Turtle, Yellow-Blotched Map (*Graptemys flavimaculata*)	Rivers and large creeks, prefers moderate currents, abundant basking sites, and sandbars (US FWS 1993, p. 2)	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies and their associated beaches.	USFWS. 1993. Recovery Plan for the Yellow-blotched Map Turtle. United States Fish and Wildlife Service

Vireo, Black-Capped (*Vireo atricapilla*)	Insect-eating, migratory songbird that arrives in Texas from mid-March to mid-April, while those in Oklahoma arrive approximately 10 days later. Breeding habitat is quite variable across its range, but is generally shrublands with a distinctive patchy structure. The shrub vegetation is mostly deciduous and generally extends from the ground to about six feet above ground and covers about 30 to 60% of the total area. Open grassland separates the clumps of shrubs. (US FWS 2007, p. 7) From Oklahoma through most of Texas, this type of vegetational configuration occurs most frequently on rocky substrates with shallow soils, in rocky gullies, on edges of ravines, and on eroded slopes. (US FWS 2007, p. 20)	The proposed 2,4-D choline uses are not expected to overlap with shrublands associated with rocky gullies, edges of ravines, or eroded slopes.	USFWS. 2007. Five Year Review. http://ecos.fws.gov/docs/five_year_review/doc1073.pdf USFWS. 1991. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/910930h.pdf
Wartyback, White (pearlymussel) (*Plethobasus cicatricosus*)	The white wartyback has undergone a substantial range reduction and is considered to be possibly extinct. It was historically distributed in the Wabash, Ohio, Kanawha, Cumberland, Holston, and Tennessee Rivers of the Ohio, Cumberland, and Tennessee River systems; however, no	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS, 1984, Recovery Plan White Warty-backed Pearlymussel http://ecos.fws.gov/docs/recovery_plan/060313h.pdf http://ecos.fws.gov/docs/life_histories/F00M.html

	live specimens have been recovered from these drainages since the early 1900s). The white wartyback may still exist in a short reach of the Tennessee River below Pickwick Dam. No living populations have been found in numerous surveys conducted in the Tennessee River since the 1960s; however, fresh dead specimens were collected in 1979 and 1982 below Pickwick Dam near Savannah, Tennessee. If this species still exists, the viability of remaining populations is extremely threatened The white wartyback is a riffle species that is typically found in large rivers in gravel substrates .		
Whale, Finback (*Balaenoptera physalus*)	Fin whales are found in deep, offshore waters of all major oceans, primarily in temperate to polar latitudes, and less commonly in the tropics. They occur year-round in a wide range of latitudes and longitudes, but the density of individuals in any one area changes seasonally.	The proposed 2,4-D choline uses are not expected to overlap with deep offshore waters.	http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/finwhale.htm
Whale, Humpback (*Megaptera novaeangliae*)	During migration, humpbacks stay near the surface of the ocean.	The proposed 2,4-D choline uses are not expected to overlap with coastal waters.	http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/humpbackwhale.htm

	While feeding and calving, humpbacks prefer shallow waters. During calving, humpbacks are usually found in the warmest waters available at that latitude. Calving grounds are commonly near offshore reef systems, islands, or continental shores. Humpback feeding grounds are in cold, productive coastal waters.		
Woodpecker, Red-Cockaded (*Picoides borealis*)	Habitat: Forest, Savannah (open pine woodlands and savannahs with large old pines) (US FWS 2003, p. x) Habitat size (home range): 116 – 357 acres (US FWS 2003, p. 49)	Proposed 2,4-D choline uses are not expected to overlap with forest or savannah.	USFWS Recovery Plan http://ecos.fws.gov/docs/recovery_plan/030320_2.pdf
Plants			
Aster, Decurrent False (*Boltonia decurrens*)	The natural habitat of the aster was the shores of lakes and the banks of streams including the Illinois River. It appears to require abundant light. It presently grows in such habitats but is more common in disturbed lowland areas where it appears to be dependent on human activity for survival (US FWS, 1990, p. 3). It occupies unimpounded floodplain habitats along the Illinois River system; the plant relies on periodic flood pulses to maintain populations and suitable habitat (US FWS, 2012, p. 7).	The proposed 2,4-D choline uses are not expected to overlap with the shores of lakes/streams or other floodplain habitats where the aster may occur.	USFWS. 1990. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/900928c.pdf USFWS. 2012. 5-Year-Review. http://ecos.fws.gov/docs/five_year_review/doc4044.pdf

Aster, Ruth's Golden (*Pityopsis ruthii*)	This species grows only in the cracks or crevices found in phyllite or graywacke boulders along the banks of or within the Ocoee and Hiwassee Rivers (US FWS, 1992).	The proposed 2,4-D choline uses are not expected to overlap with rivers.	USFWS. 1992. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/920611.pdf
Avens, Spreading (*Geum radiatum*)	This species grows in full sun on the shallow acidic soils of high-elevation cliffs, rocky outcrops, steep slopes, and on gravelly talus (US FWS, 1993).	The proposed 2,4-D choline uses are not expected to overlap with high-elevation cliffs, rocky outcrops, steep slopes or gravelly talus.	USFWS. 1993. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/930428.pdf
Bladderpod, Missouri (*Physaria filiformis*)	This species grows in shallow soils on limestone glades and outcrops in pastures and rarely in rocky open woods. Grows in shallowest soils with other annuals where bare soil occurs and few perennials are present. Burlington limestone of Mississippian age (US FWS, 1998).		USFWS. 1998. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/880407.pdf
Bluet, Roan Mountain (*Hedyotis purpurea* var. *montana*)	This species grows in shallow soils and crevices of cliffs and outcrops and on thin rocky soils of grassy balds (US FWS, 1996).	The proposed 2,4-D choline uses are not expected to overlap with cliffs and outcrops.	USFWS. 1996. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/960513.pdf
Bush-Clover, Prairie (*Lespedeza leptostachya*)	The prairie bush clover occurs on both undisturbed and disturbed sites over sandy, loam, or gravelly soils included at the thin margins near rock outcrops. Sites may have been previously mowed, burned or grazed (US FWS, 1988, p. 7-8).	The proposed 2,4-D choline uses are not expected to overlap with prairies.	USFWS. 1988. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/881006.pdf
Butterfly Plant, Colorado (*Gaura neomexicana*	This species requires early- to mid-succession riparian habitat. It commonly	The proposed 2,4-D choline uses are not expected to overlap with	USFWS. 2010. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/Colorado%20Butte

var. *coloradensis*)	occurs in habitat types that are usually intermediate in moisture between wet, streamside communities dominated by sedges, rushes, and cattails, and dry, upland short-grass prairie. Typically, Colorado butterfly plant habitat is open, without dense or overgrown vegetation (US FWS, 2010).	riparian habitat or upland prairies.	rfly%20Plant%20Recovery%20Outline_Final_May%202010.pdf
Chaffseed, American (*Schwalbea americana*)	Habitats described as pine flatwoods, fire-maintained savannas, ecotonal areas between peaty wetlands and xeric sandy soils, and other open grass-sedge systems (US FWS, 1995).	The proposed 2,4-D choline uses are not expected to overlap with pine flatwoods, fire-maintained savannas, wetland or sedge dominated systems.	USFWS. 1995. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/950929c.pdf
Clover, Running Buffalo (*Trifolium stoloniferum*)	Running buffalo clover occurs in mesic habitats of partial to filtered sunlight, where there is a prolonged pattern of moderate periodic disturbance, such as mowing, trampling, or grazing. It is most often found in regions underlain with limestone or other calcareous bedrock. Specific habitats include mesic woodlands, savannahs, floodplains, stream banks, sandbars, grazed woodlots, mowed paths (e.g. cemeteries, parks), old logging roads, jeep trails, ATV trails, skid trails, mowed wildlife openings within mature forest, and steep ravines. It has been suggested that the original habitat may	The proposed 2,4-D choline uses are not expected to overlap with mesic habitats where the clover is expected to be found.	USFWS. 2007. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/070627.pdf

	have been open woods or savannah, and bison herbivory on associated species may have kept the habitats open (US FWS, 2007, p. 12.).		
Fern, American Hart's-Tongue (*Asplenium scolopendrium* var. *americanum*)	Early successional habitats Northern populations occur in forests of secondary growth where canopy openings are abundant. New Yoprk populations occur in conifer forests. Bryophyte beds are an important substrate.	The proposed 2,4-D choline uses are not expected to overlap early successional forests, conifer forests or bryophyte beds where the species is found..	http://ecos.fws.gov/docs/recovery_plan/930915.pdf
Geocarpon minimum (No common name)	This species grows on sandstone glades and outcrops as well as bare, sparsely vegetated areas where the soil contains relatively large amounts of magnesium and sodium salts (US FWS, 1993).	The proposed 2,4-D choline uses are not expected to overlap with the sandstone glades and outcrops where this species is expected to be found.	USFWS. 1993. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/930726.pdf
Goldenrod, Blue Ridge (*Solidago spithamaea*)	This species grows on rock outcrops and vertical to near vertical cliffs in southern Appalachians of western North Carolina and extreme eastern TN. Rocky summits and cliffs usually appear as smaller-scale patchy habitats embedded in larger forest consisting of	The proposed 2,4-D choline uses are not expected to overlap with rock outcrops and vertical cliffs.	USFWS. 1987. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/blueridge%20goldenrod%20rp.pdf

	spruce-fir or northern hardwoods or occasionally high elevation red oak forest (US FWS, 1987).		
Grass, Tennessee Yellow-Eyed (*Xyris tennesseensis*)	Xyris tennessensis is a rare perennial monocot that is an obligate wetland plant that prefers relatively high pH seeps and streambanks. An Obligate wetland plant that is restricted to calcareous seeps, fens, and spring runs (US FWS, 2014).	The proposed 2,4-D choline uses are not expected to overlap with wetlands.	USFWS. 2014. Five Year Review. http://ecos.fws.gov/docs/five_year_review/doc4360.pdf
Ground-Plum, Guthrie's (=Pyne's) (*Astragalus bibullatus*)	This species is endemic to cedar glades (US FWS, 2011).	The proposed 2,4-D choline uses are not expected to overlap with cedar glades.	USFWS. 2011. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/20110722b_Pynes%20ground%20plum_RP_final_1.pdf
Harperella (*Ptilimnium nodosum*)	Harperella is known from only two locations in North Carolina. One population occurs in the Tar River in Granville County. Another population was reintroduced to the Deep River recently after the original population known from that area disappeared. This population occurs in Chatham County, but the river serves as the divide between Chatham and Lee counties (US FWS, 1991).	The proposed 2,4-D choline uses are not expected to overlap with river habitats.	USFWS. 1991. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/910305b.pdf
Ladies'-Tresses, Ute (*Spiranthes diluvialis*)	Occurs in relatively low elevation riparian, spring, and lakeside wetland meadows. Endemic to moist soils in mesic or wet meadows near springs, lakes, or perennial	The proposed 2,4-D choline uses are not expected to overlap with riverine, spring, or lakeside wet meadows.	USFWS. 1995. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/950921.pdf USFWS. Species Profile Page.

	streams. Occur primarily in areas where the vegetation is relatively open and not overly dense or overgrown, but some populations als found in riparian woodlands. Observed to be shade-intolerant (US FWS, 1995). Occurs in relatively low elevation riparian, spring, and lakeside wetland meadows. Endemic to moist soils in mesic or wet meadows near springs, lakes, or perennial streams. Occur primarily in areas where the vegetation is relatively open and not overly dense or overgrown, but some populations are found in riparian woodlands. Observed to be shade-intolerant (US FWS, Species Profile Page).		http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=Q2WA
Lichen, Rock Gnome (*Gymnoderma lineare*)	Rock gnome lichen is primarily limited to vertical rock faces where seepage water from forest soils above flows during (and only during) very wet times. It appears the species needs a moderate amount of light, but that it cannot tolerate high-intensity solar radiation. It does well on moist, generally open, sites, with northern exposures, but needs at least partial canopy coverage where the aspect is southern or western	The proposed 2,4-D choline uses are not expected to overlap with high elevation verticle rock faces where the species occurs..	http://www.fws.gov/raleigh/species/es_rock_gnome_lichen.html

	Rock gnome lichen is known from the Southern Appalachian Mountains of North Carolina and South Carolina, Tennessee, and Georgia, in areas of high humidity, either at high elevations, where it is frequently bathed in fog, or in deep gorges at lower elevations.		
Lily, Minnesota Dwarf Trout (*Erythronium propullans*)	The Minnesota dwarf trout lily is most commonly found in the lower parts of wooded north-facing slopes, and on adjacent floodplains. Sites are associated either with streams or abandoned stream channels, dominated by deciduous trees. It may be intolerant of shade (US FWS, 1987).	The proposed 2,4-D choline uses are not expected to overlap with woodlands or floodplains.	USFWS. 1987. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/060309c.pdf
Milkweed, Mead's (*Asclepias meadii*)	Mead's milkweed occurs primarily in tallgrass prairie with a late successional bunch-grass structure, but also occurs in hay meadows and in thin soil glades or barrens. This plant is essentially restricted to sites that have never been plowed and only lightly grazed, and hay meadows that are cropped annually for hay (US FWS, 2003, p. 9).	The proposed 2,4-D choline uses are not expected to overlap with tallgrass prairies, hay meadows, or thing soil glades or barrens.	USFWS. 2003. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/030922b.pdf
Orchid, Eastern Prairie Fringed (*Platanthera leucophaea*)	The eastern prairie fringed orchid occurs in a wide variety of habitats, from mesic prairie to wetland communities such as sedge meadows, marsh edges and even fens and	The proposed 2,4-D choline uses are not expected to overlap with grass or sedge-dominated plant communities.	USFWS. 1999. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/990929.pdf

	sphagnum bogs. It requires full sunlight for optimum growth and flowering, which restricts it to grass- and sedge-dominated plant communities. The substrate of the sites where it occurs ranges from more or less neutral to mildly calcareous, typically glacial soils. It is often early successional, but can be maintained in mid- to late successional wetlands that remain open and sunny (US FWS, 1999, pp. 6-7).		
Orchid, Western Prairie Fringed (*Platanthera praeclara*)	The western prairie-fringed orchid occurs primarily in tall grass prairies dominated by bluestem grass and in sedge meadows that are seasonally wet (US FWS, 1996, p. 6). They also may occur in successional communities such as borrow pits, old fields, and roadside ditches (US FWS, 1996, p. 4).	The proposed 2,4-D choline uses are not expected to overlap with prairie, meadow areas, roadside ditches, borrow pits or abandoned fields.	USFWS. 1996. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/960930a.pdf
Penstemon, Blowout (*Penstemon haydenii*)	This species grows in depressions in the topography caused by wind erosion. Vegetation associated with blowouts is distinctly different than vegetation associated with adjacent, noneroding areas. In Wyoming, blowout penstemon is found primarily on the rim and lee slopes of blowouts, or the rim	The proposed 2,4-D choline uses are not expected to overlap with sandy slough slopes or dunes.	USFWS. 1992. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/920717.pdf

	and steep faces of sandy slough slopes. These deposits are found at the base of mountains or ridges, which represent topographic barriers. Shifting sand dunes are prevented from becoming fully stabilized and overgrown because of wind and gravity. The dunes may be 60 to 120 feet high (US FWS, 1992).		
Pitcher-Plant, Green (*Sarracenia oreophila*)	Habitats for this species can be generally grouped into two types: stream banks (considered ephemeral) and upland bogs. Upland bogs, fire dependent, range from open to forested, underlain by semi-impervious clay layers (US FWS, 1994).	The proposed 2,4-D choline uses are not expected to overlap with stream banks or upland bogs.	USFWS. 1994. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/941212.pdf
Pogonia, Small Whorled (*Isotria medeoloides*)	The small whorled pogonia occurs on upland sites in mixed-deciduous or mixed deciduous/coniferous forests that are generally in second- or third-growth successional stages. It occurs on both fairly young and maturing forest stands. Most occurrences include sparse to moderate ground cover in the species' microhabitat, a relatively open understory canopy, and proximity to features that create long persisting breaks in the forest canopy. Soils at most sites are highly	The proposed 2,4-D choline uses are not expected to overlap with mixed deciduous/coniferous forests.	USFWS. 1992. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/921113b.pdf

	acidic and nutrient poor, with moderately high soil moisture values. Light availability could be a limiting factor for this species. The one Illinois site is unusual in being on a dry, steep, thinly forested slope atop a vertical sandstone bluff. The one Ohio site is along the Ohio River in a typical Appalachian-type forest association (US FWS, 1992, pp. 23-24).		
Pondberry (*Lindera melissifolia*)	Associated with seasonally flooded wetlands. Found on wet edges of sandy sinks, ponds, and swampy depressions. Shade tolerant (US FWS, 1993).	The proposed 2,4-D choline uses are not expected to overlap with wetlands.	USFWS. 1993. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/930923a.pdf
Potato-Bean, Price's (*Apios priceana*)	Found in open forests along the edges of forests, creeks, and rivers (US FWS, 1993, p. executive summary).	The proposed 2,4-D choline uses are not expected to overlap with forests, or water bodies.	USFWS. 1993. Recovery Plan http://ecos.fws.gov/docs/recovery_plan/930210.pdf
Prairie-Clover, Leafy (*Dalea foliosa*)	Leafy prairie-clover is found only in open limestone cedar glades, limestone barrens, and dolomite prairies which have shallow, silt to silty clay loam soils over flat and often highly fractured, horizontally bedded limestone or dolomite with frequent expanses of exposed bedrock at surface. Elevations are typically between 550 and 700 feet. These habitats experience high surface and soil temperatures, generally have low soil moisture	The proposed 2,4-D choline uses are not expected to overlap with prairies or areas with visible bedrock.	USFWS. 1996. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/900919b.pdf

	but are wet in the spring and fall and become droughty in summer. The distribution of glade, barren, and dry to wet dolomite prairie at any particular site varies and leads to a mosaic of soils and their associated plant communities (USFWS, 1996, p.13).		
Quillwort, Louisiana (*Isoetes louisianensis*)	This species grows in sandy soils and gravel bars in or near shallow blackwater streams and overflow channels in riparian woodland. bayhead forests of fine flatwoods and upland longleaf pine (US FWS, 1996).	The proposed 2,4-D choline uses are not expected to overlap with streams, overflow channels, or riparian woodlands.	USFWS. 1996. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/960930b.pdf
Rock-Cress, Braun's (*Arabis perstellata*)	Braun's rockcress occurs on the slopes of calcareous mesophytic and sub-xeric forest types. The occurrence of this species does not appear to be limited to a particular slope aspect, elevation, or moisture regime within the slope forests. It is, however, sun intolerant and always occurs in at least partial shade. The largest and most vigorous populations occur on moist mid- to upper slope sites. Plants are often found around rock outcrops, protected sites on the downslope side of tree bases, and sites of natural disturbance, such as talus slopes and animal trails. It is rarely found growing among the Leaf litter and herbaceous cover of the	The proposed 2,4-D choline uses are not expected to overlap with calcareous mesophytic and sub-xeric forested systems.	USFWS. 1997. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/970722.pdf

	forest floor (US FWS, 1997).		
Rosemary, Cumberland (*Conradina verticillata*)	This species is found on rocky river bars composed of unsorted boulders, cobbles, gravel and sand, with the largest populations occurring in open, washed-out areas near the centers of these bars. The essential habitat requirements of this species are: open to barely shaded sites; moderately deep, sandy, well-drained soils with no visible organic matter; periodic forceful flooding to maintain openness; topographic features to enhance sand deposition; and, perhaps, periods of inundation of at least two weeks to induce rooting at the lower nodes (pg. 8) (US FWS, 2011).	The proposed 2,4-D choline uses are not expected to overlap with rivers.	USFWS. 2011. Five Year Review. http://ecos.fws.gov/docs/five_year_review/doc3629.pdf
Roseroot, Leedy's (*Rhodiola integrifolia ssp. leedyi*)	New York populations occur on cliffs along the western shore of Seneca lake. In Minnesota, populations occur on maderate cliffs, which are cooled by air exiting underground passages in the karst topography (US FWS, 1998).	The proposed 2,4-D choline uses are not expected to overlap with cliffs.	USFWS. 1998. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/980925.pdf
Sandwort, Cumberland (*Arenaria cumberlandensis*)	This species is restricted to sandstone rock houses, ledges, and solution pockets on sandstone rock faces; The species is found on the sandy floors of rock houses, in solution pockets on the face of sandstone cliffs, and on ledges beneath	The proposed 2,4-D choline uses are not expected to overlap with sandstone rock houses, ledges, or rock faces.	USFWS. 1996. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/960620.pdf

	overhanging sandstone (pg. 4) (US FWS, 1996).		
Skullcap, Large-Flowered (*Scutellaria montana*)	This species occurs in slope, ravine, and stream-bottom forests in northwestern Georgia and adjacent southeastern Tennessee. Habitat loss and lack of information on appropriate management are the factors limiting the number of viable populations (US FWS, 1996).	The proposed 2,4-D choline uses are not expected to overlap with ravine and stream-bottom forests.	USFWS. 1996. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/960515.pdf
Sneezeweed, Virginia (*Helenium virginicum*)	Seasonal wetlands, sink hole ponds varying from forest settings to farm pond margins.	The proposed 2,4-D choline uses are not expected to overlap sink hole ponds and seasonal wetlands.	http://ecos.fws.gov/docs/recovery_plan/001002.pdf
Spiraea, Virginia (*Spiraea virginiana*)	*Spiraea virginiana* is found along the banks of high gradient sections of second and third order streams, or on meander scrolls and point bars, natural levees, and other braided features of lower reaches (often near the stream mouth). The habitat is in oft-disturbed early successional areas. Occasional flood scouring reduces shading and seems to be essential, although the spiraea can tolerate some overstory growth (US FWS, 1992, pp.17-18.).	The proposed 2,4-D choline uses are not expected to overlap with rivers, streams, creeks, or other water bodies.	USFWS. 1992. Recovery Plan. http://ecos.fws.gov/docs/recovery_plan/921113a.pdf

Appendix 3

Lesser Prairie-Chicken Habitat Characteristic Studies Summarized in Jamison (2000)

Study	Location(s)	Habitat(s) Studied	Species-Specific Habitat Characteristics
1	New Mexico	Cropland, idle, shinnery oak (*Quercus havardii*) pasture, shortgrass pasture, tame pasture	Hens with broods preferred shinnery oak pasture over cropland, fallow cropland, shortgrass, and tame pastures; broods used sites characterized by 25% canopy cover of vegetation, canopy height of about 30 cm, 24-39% basal composition of shrubs, 47-60% grasses, and 13-26% basal composition of forbs; adults used grain sorghum fields during autumn and winter
2	Kansas	Cropland, sand sagebrush (*Artemisia filifolia*) pasture	Nested in sand sagebrush pasture and foraged in cropland during winter
3	Oklahoma	Burned shinnery oak pasture, burned tame pasture, shinnery oak pasture	Continued to display at a lek in burned pasture; males relocated from an unburned lek to a historical site in a burned weeping lovegrass (*Eragrostis curvula*) pasture and initiated display at a new site in burned shinnery oak/bluestem (*Andropogon*) pasture
4	Oklahoma	Sand sagebrush pasture, shinnery oak pasture	Densities of birds in shinnery oak pasture were positively correlated with grass cover and grass frequency along transects, and with percent of grassland cover types identified from satellite imagery; in sand sagebrush pasture, numbers of birds were positively correlated with percent cover of shrubs and grass frequency along transects, but were not associated with percentages of cover types identified from satellite imagery
5	Oklahoma	Cropland, mixed-grass pasture, sand sagebrush pasture, shinnery oak pasture	Nested in residual grasses and shinnery oak; raised broods in shinnery oak thickets; foraged in cropland (food plots) during winter
6	Texas	Honey mesquite (*Prosopis glandulosa*)/shortgrass pasture, shinnery oak pasture	Preferred pastures dominated by shinnery oak and sand bluestem (*Andropogon hallii*); avoided honey mesquite/shortgrass areas; nested more successfully in residual sand bluestem than in other vegetation types; selected nest sites with north or northeast aspects, more litter and less bare ground than elsewhere in the habitat, and taller vegetation than the average vegetation height within 3 m; broods preferred shinnery oak/sand bluestem pasture and avoided mesquite/shortgrass habitat; broods foraged at sites with a minimum vegetation height of 24 cm and lower grass abundance and greater shrub abundance than generally was available
7	Oklahoma	Cropland, native pasture	Displayed on sparsely vegetated, flat-topped ridges overlooking expansive areas of native pasture and on slightly raised knolls that provided unobstructed views of broad valleys

Study	Location(s)	Habitat(s) Studied	Species-Specific Habitat Characteristics
8	Oklahoma	Sand sagebrush pasture, shinnery oak pasture	More individuals were encountered in phenoxy herbicide-treated shinnery oak and phenoxy herbicide-treated sand sagebrush pastures than in untreated habitats of the same types
9	Colorado	Sand sagebrush pasture	Nested among taller grasses (36 vs. 27 cm), forbs (21 vs. 16 cm), and shrubs (48 vs. 38 cm), and denser vegetation (32 vs. 20 cm) compared to areas within 5 m; nested mostly under sand sagebrush and yucca (*Yucca glauca*); at 29 nest sites, tallest vegetation averaged 51 cm, sand sagebrush plant density was 3471 plants/ha, sand sagebrush cover was 7.2%, grass cover was 29.4%, forb cover was 1.4%, and bare ground was 69.5%
10	Texas	Shinnery oak/sand sagebrush pasture	Selected untreated shinnery oak pastures for nesting over tebuthiuron-treated pastures of the same type; eight of 10 females that were captured in tebuthiuron-treated areas later nested in untreated shinnery oak; 13 nests were in residual grasses with 42% overhead cover, average plant height of 45 cm, and average visual obstruction of 61-80% in the first 33 cm above ground; vegetation was dominated by purple three-awn (*Aristida purpurea*) at nine nest sites, little bluestem (*Schizachyrium scoparium*) at three nests, and sand bluestem at one nest
11	Colorado	Cropland, mixed-grass pasture, sand sagebrush pasture	Males displayed at lek sites on slightly elevated terrain or on level flats; foraged in cropland during winter
12	Texas	Cropland, sand sagebrush pasture, shinnery oak pasture	Used pastures vegetated by sand sagebrush, chickasaw plum (*Prunus angustifolia*), fragrant sumac (*Rhusaromatica* var. *trilobata*), shinnery oak, sand bluestem, little bluestem, sand lovegrass (*Eragrostis trichodes*), sand dropseed (*Sporobolus cryptandrus*), thin paspalum (*Paspalum setaceum*), switchgrass (*Panicum virgatum*), Indiangrass (*Sorghastrum nutans*), and various forbs; foraged in cropland during winter
13	Kansas	Cropland, sand sagebrush pasture	Males preferred habitats vegetated by sand sagebrush, blue grama (*Bouteloua gracilis*), sideoats grama (*Bouteloua curtipendula*), paspalum (*Paspalum* sp.), bluestem, western ragweed (*Ambrosia psilostachya*), sunflowers (*Helianthus* spp.), Russian-thistle (*Salsola iberica*), prickly pear (*Opuntia* sp.), and yucca and used cultivated fields, tallgrass and CRP, and other grassland habitats less than expected; median sizes of areas used by males were 12-140 ha in April and May, 77-144 ha from June through September, and 229-409 ha in October and November
14	Oklahoma	Sand sagebrush/mixed-grass pasture	Displayed in areas dominated by buffalograss; raised broods in areas with 22.8% sand sagebrush and 15.7% western ragweed; foraged in mixed-grass, rested among shrubs, and nested in residual grasses; broods also used shrubs; on a year-round basis, foraged mostly in grass, especially mixed-grass 25-80 cm in height; tallgrass, shortgrass, and shrub vegetation were used equally; sixweeks fescue (*Festuca octoflora*) and fragrant sumac were important food items; during spring, used shrubs <80

Study	Location(s)	Habitat(s) Studied	Species-Specific Habitat Characteristics
			cm tall; used grasses and forbs 25-80 cm in height during summer, and grasses 25-80 cm tall during autumn; in winter, used tallgrass (specific heights of tallgrass species were not given)
15	New Mexico	Cropland, shinnery oak/sand sagebrush pasture	Used pastures vegetated by shinnery oak, bluestem grasses, sand sagebrush, sunflower, honey mesquite, plum, yucca, dropseed, black grama (*Bouteloua eriopoda*), blue grama, and sideoats grama; foraged in grain sorghum and corn fields from fall through spring
16	New Mexico, Oklahoma, Texas	Cropland, shinnery oak pasture, shinnery oak/little bluestem pasture	Annual rates of habitat change were greater around leks with declining populations than at leks with stable populations (1.14% vs. 0.21% annually)
17	New Mexico	Shinnery oak pasture, shortgrass pasture	Displayed on oil pads and in native pasture
18	New Mexico	Cropland, oldfield, shinnery oak pasture, shortgrass pasture, tame pasture	Nested in shinnery oak habitats with little bluestem, sand bluestem, and purple three-awn; avoided weeping lovegrass, cultivated, oldfield, and shortgrass habitats
19	New Mexico, Texas	Shinnery oak/sand sagebrush pasture	Occurred in similar densities in tebuthiuron-treated and untreated shinnery oak pastures
20	New Mexico	Shinnery oak pasture, shortgrass pasture	Nested in shinnery oak habitats dominated by sand bluestem; vegetation was taller at 10 successful than 26 unsuccessful nests (67 vs. 35 cm); percent composition of shrubs was similar at successful and unsuccessful nests (basal composition 31-66%); 22 autumn foraging sites were 63% grasses and 37% shrubs, 50 winter sites were 59% grasses and 41% shrubs (forbs were rare); broods foraged in 25-cm tall shinnery oak and three-awn (*Aristida* sp.), bare ground at 12 sites averaged 63%, basal composition of vegetation was 43% grass, 42% shrubs, and 15% forbs; daily movements of 40 prenesting females were 390 m/day within 231-ha ranges; 12 nesting hens moved 250 m/day, and ranges averaged 92 ha; three hens with broods moved an average of 280 m/day within 119-ha ranges; movements of 19 females without broods was 220 m/day within 73-ha ranges
22	New Mexico	Shinnery oak/sand sagebrush pasture	Hens generally used habitats with large unstable sand dunes, abundant shinnery oak, low grass cover, and low structural density; nested in sand sagebrush, residual grasses, and shinnery oak; five of eight nests were under sand sagebrush, two nests were in purple three-awn, and one nest was in shinnery oak; visual obstruction and canopy cover of sand sagebrush were significantly higher at nest sites than in surrounding habitat (specific values for visual obstruction, canopy cover, and canopy height were not given)
23	Texas	Cropland, oldfield, shinnery oak pasture, shortgrass pasture, tame pasture	Prenesting and nesting hens preferred shinnery oak habitat characterized by rolling dunes and dominated primarily by shinnery oak, habitat dominated by little bluestem and sand bluestem, or habitat dominated by three-awn and shinnery

Study	Location(s)	Habitat(s) Studied	Species-Specific Habitat Characteristics
			oak; canopy coverage of grasses within 3 m of nest sites was 3.1-13.2%, shrub canopy was 21.4-28.3%, and canopy coverage of all vegetation was 31.4-38.4%; nests in grasses were more successful (4 of 5 successful) than those under shrubs (3 of 10 successful)
24	New Mexico	Cropland, oldfield, shinnery oak pasture, shortgrass pasture, tame pasture	Prenesting and nesting hens preferred shinnery oak habitat characterized by rolling dunes and dominated primarily by shinnery oak, habitat dominated by little bluestem and sand bluestem, or habitat dominated by three-awn and shinnery oak; canopy coverage of grasses within 3 m of nest sites was 3.1-13.2%, shrub canopy was 21.4-28.3%, and canopy coverage of all vegetation was 31.4-38.4%; nests in grasses were more successful (4 of 5 successful) than those under shrubs (3 of 10 successful)
25	New Mexico, Oklahoma, Texas	Cropland, shinnery oak pasture, shinnery oak/little bluestem pasture	Populations stabilized or increased in landscapes (7238-ha areas) in which low-density shrubland composed 79.% of the total area and declined in landscapes with 43.2% low-density shrubland; total shrubland composed 81.9% around leks that did not decline and 63.4% of the landscape around declining leks; declined in areas where landscapes were unstable (e.g., experienced frequent changes from one landcover to another); population trends were positively correlated with loss of total shrubland